



OVERVIEW OF EARLY ACTION COMPACT (EAC) MODELING USING THE ATMOS DATABASES

4 March 2003
Nashville, Tennessee

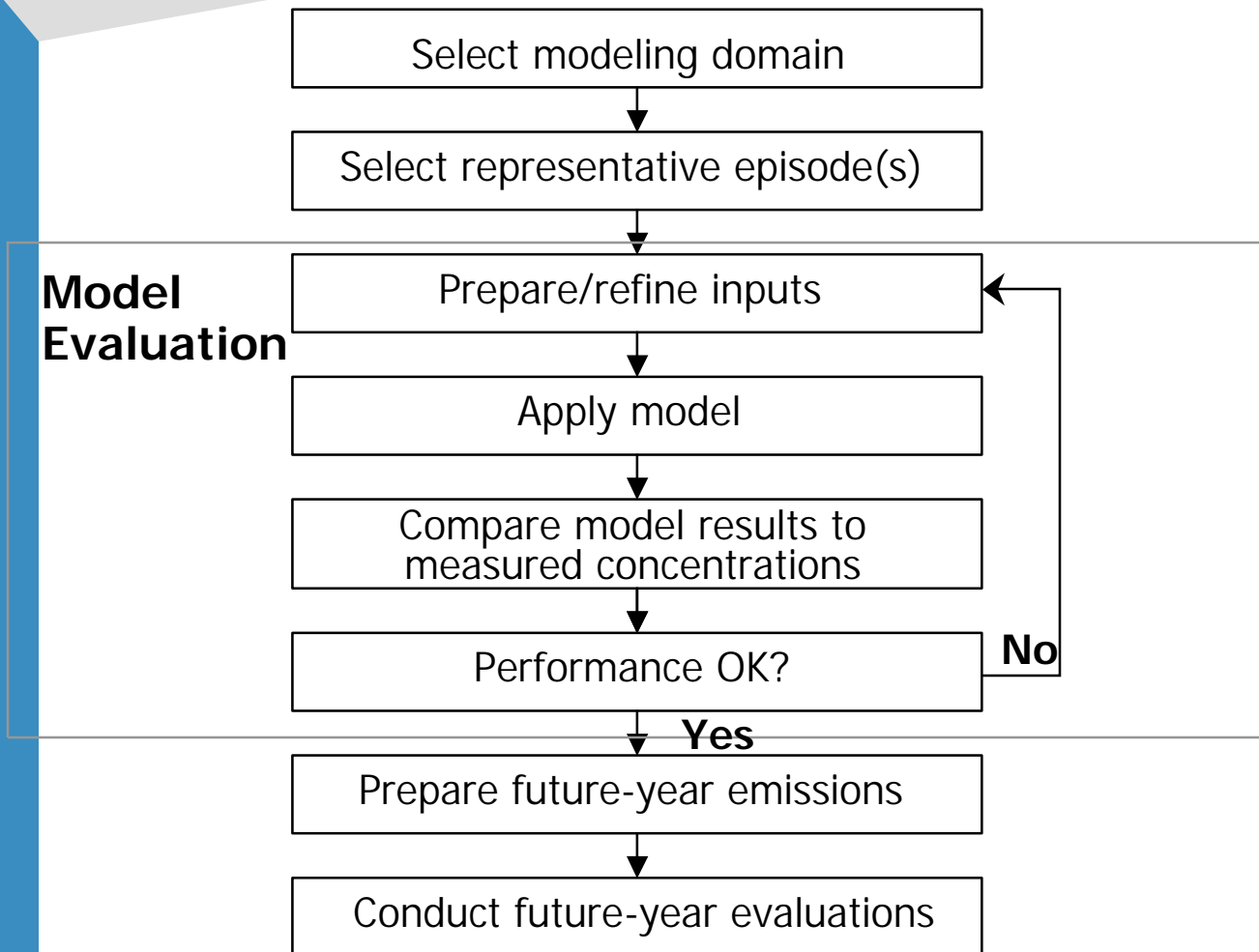
Presented by
Jay Haney
Systems Applications International (SAI)
San Rafael, CA



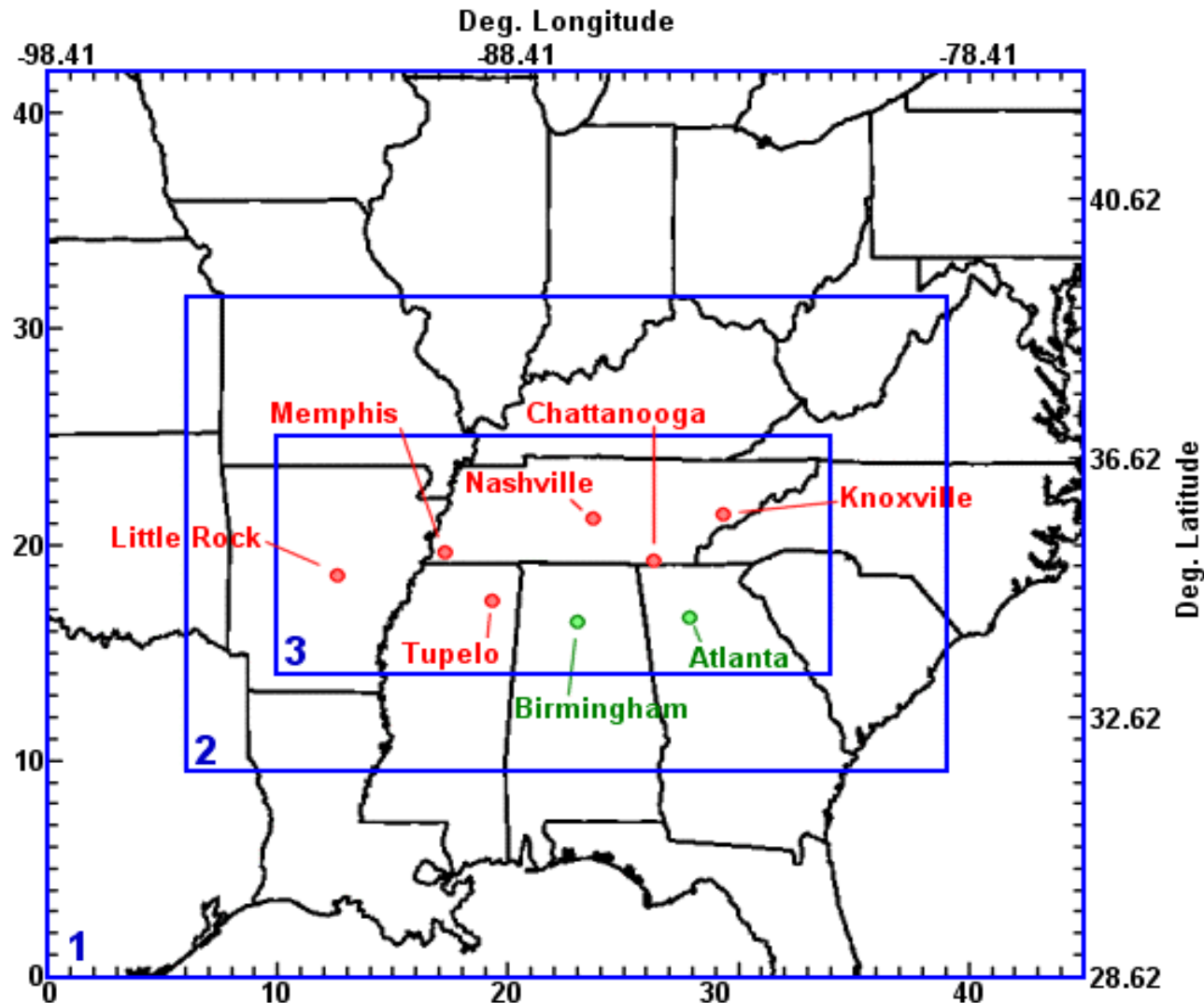
FIRST, A BRIEF REVIEW OF SOME KEY ATMOS STUDY ELEMENTS

- Modeling process
- Modeling domain
- Simulation period/8-hr ozone exceedances
- Modeling system (tools and procedures)
- Web site (<http://atmos.saintl.com>)

TYPICAL MODEL APPLICATION PROCESS



ATMOS UAM-V MODELING DOMAIN



Grid 1: (-98.41,28.62) – 45x42 – 36-km Cells

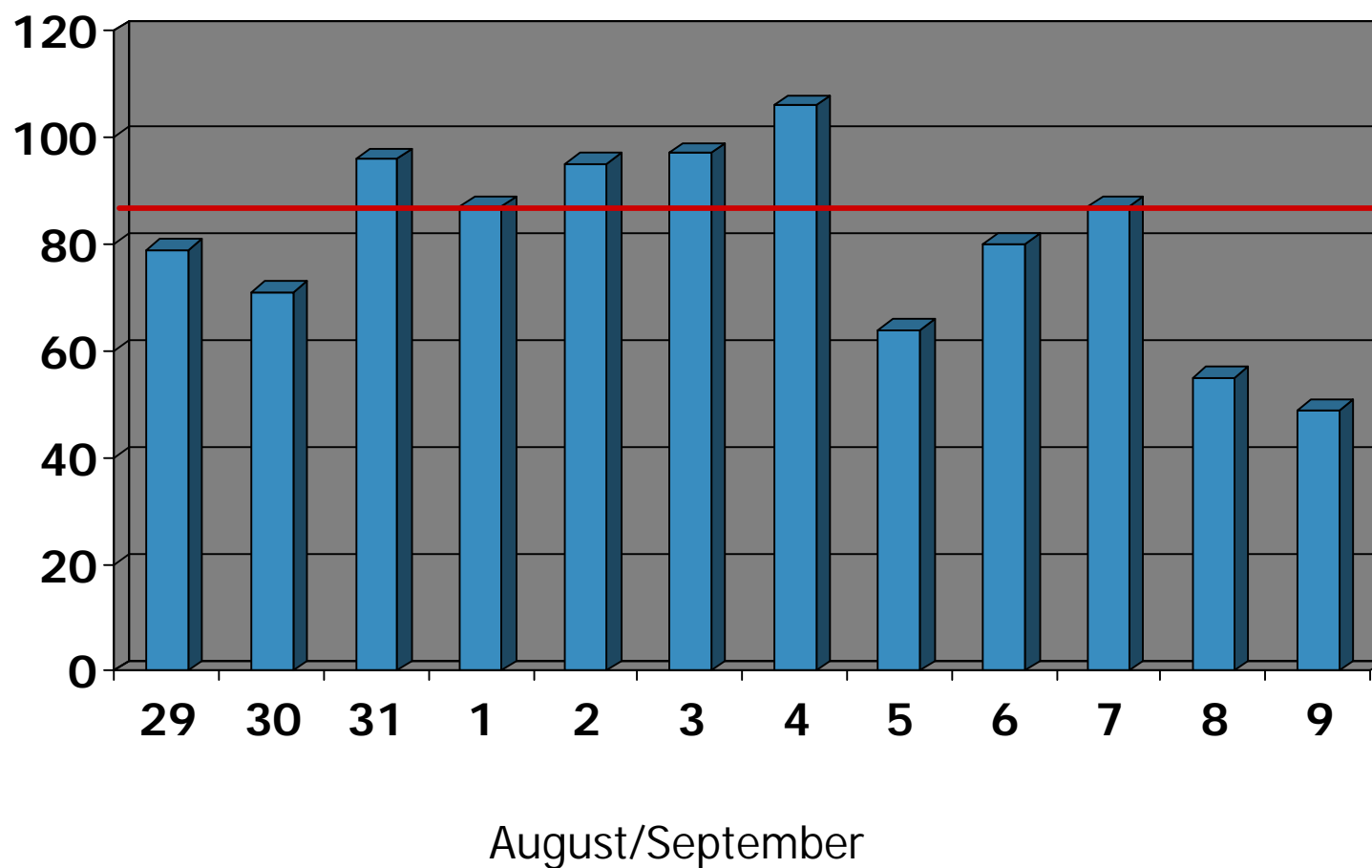
Grid 2: (-95.41, 31.79) – 99x66 – 12-km Cells

Grid 3: (-93.41, 33.29) – 216x99 – 4-km Cells

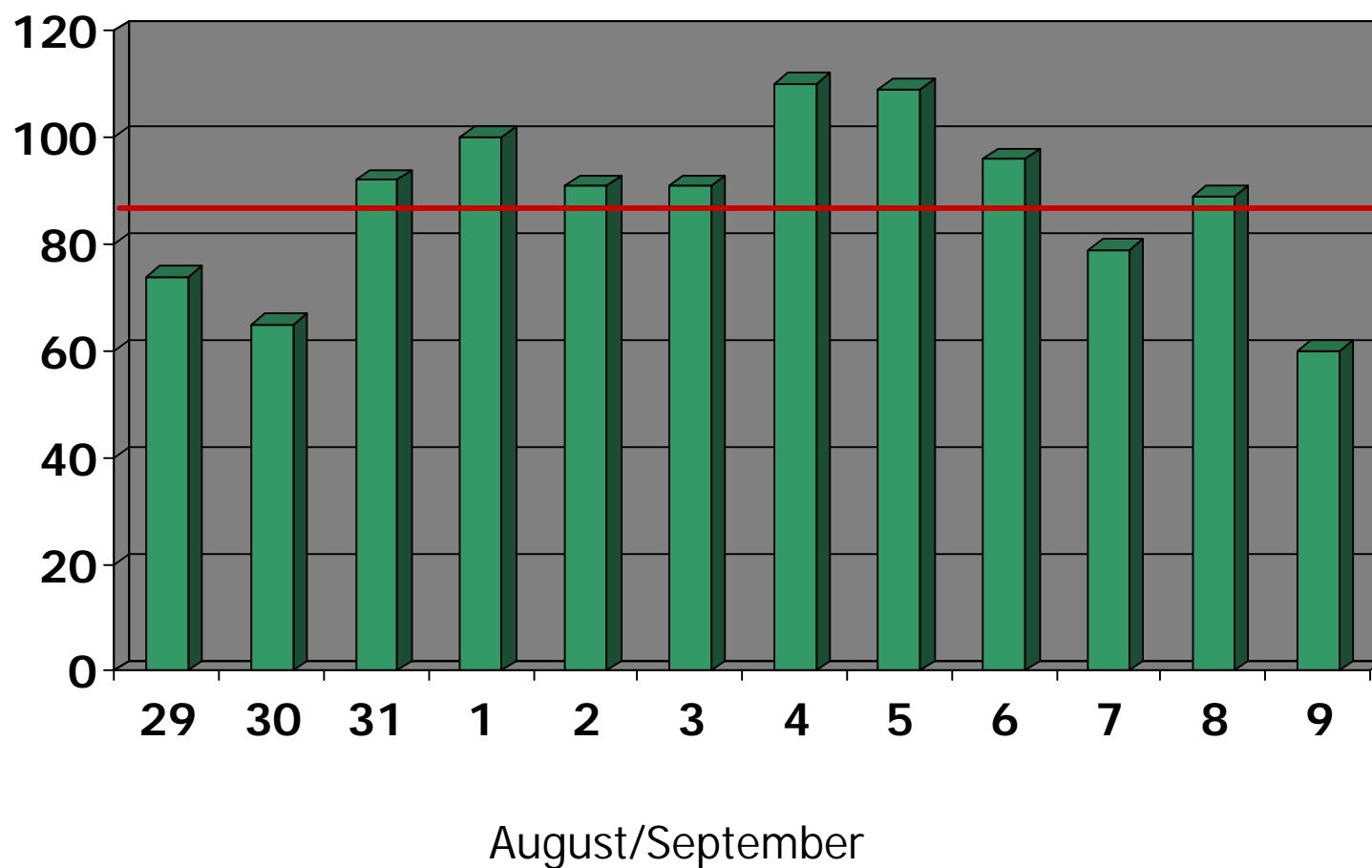
ATMOS SIMULATION PERIOD

- 29 August – 9 September 1999
 - 12 simulation days
 - Sunday through Thursday
 - high ozone day(s) for each of the areas of interest
 - Memphis
 - Nashville
 - Knoxville
 - Chattanooga
 - Tupelo
 - Little Rock

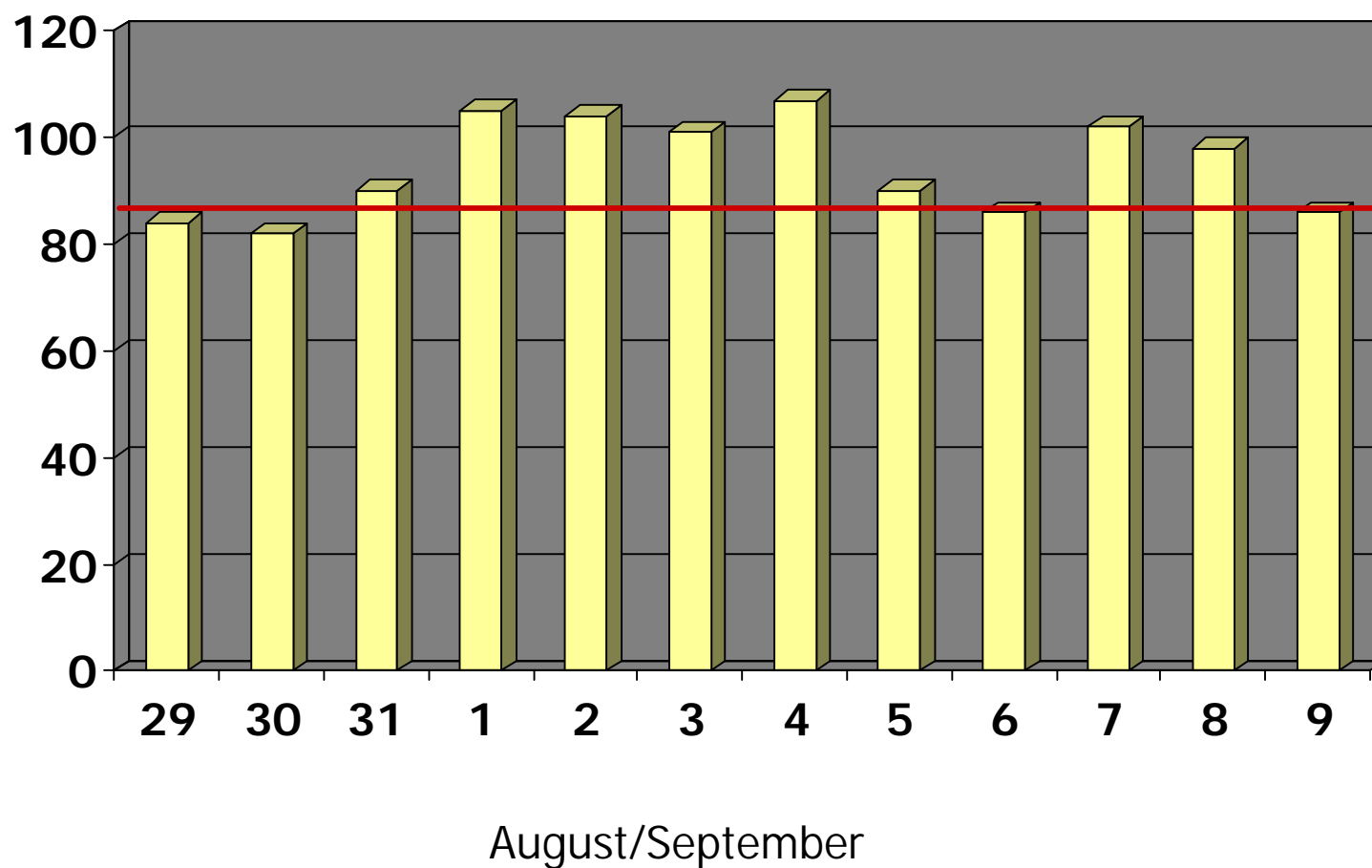
MAXIMUM 8-HOUR OZONE (PPB): MEMPHIS



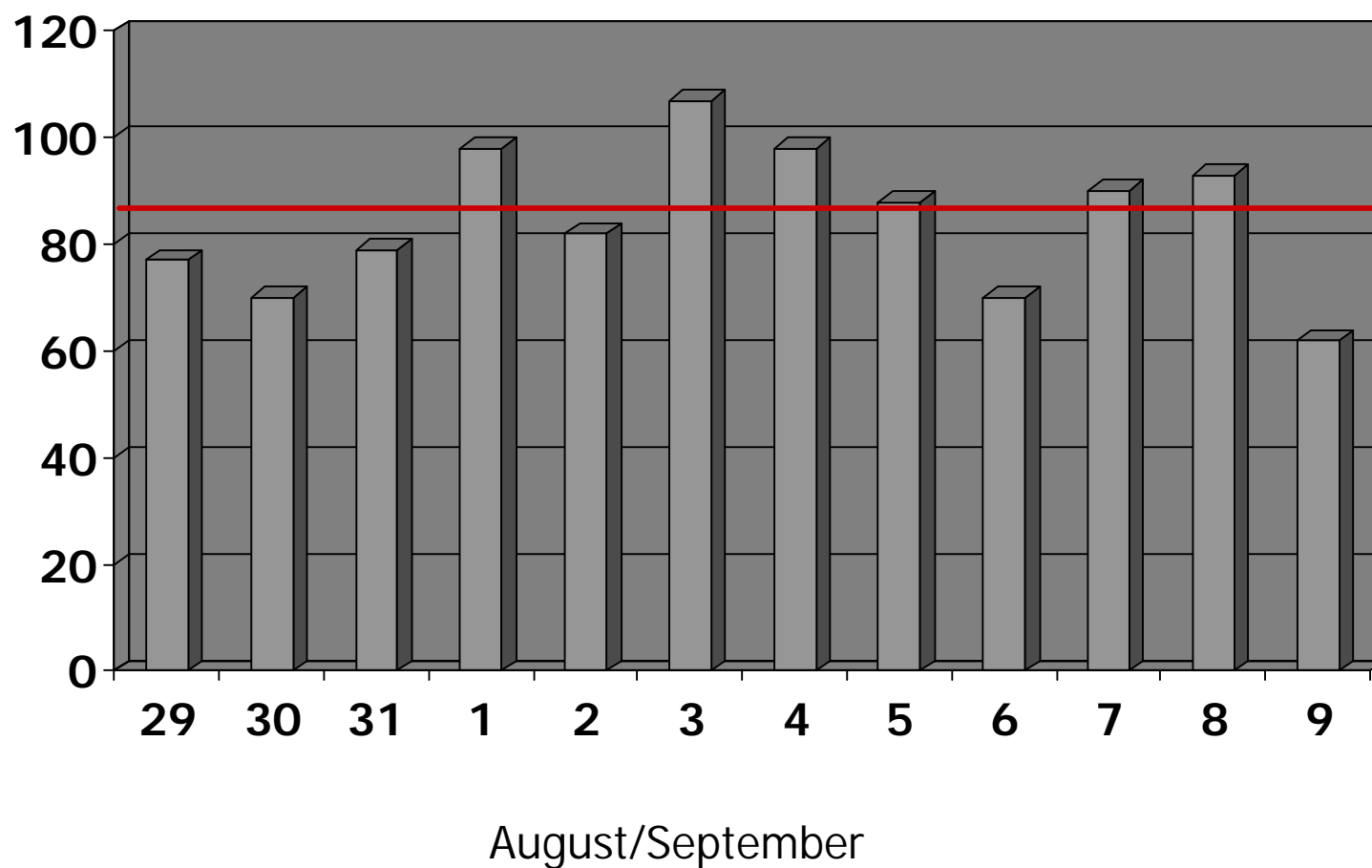
MAXIMUM 8-HOUR OZONE (PPB): NASHVILLE



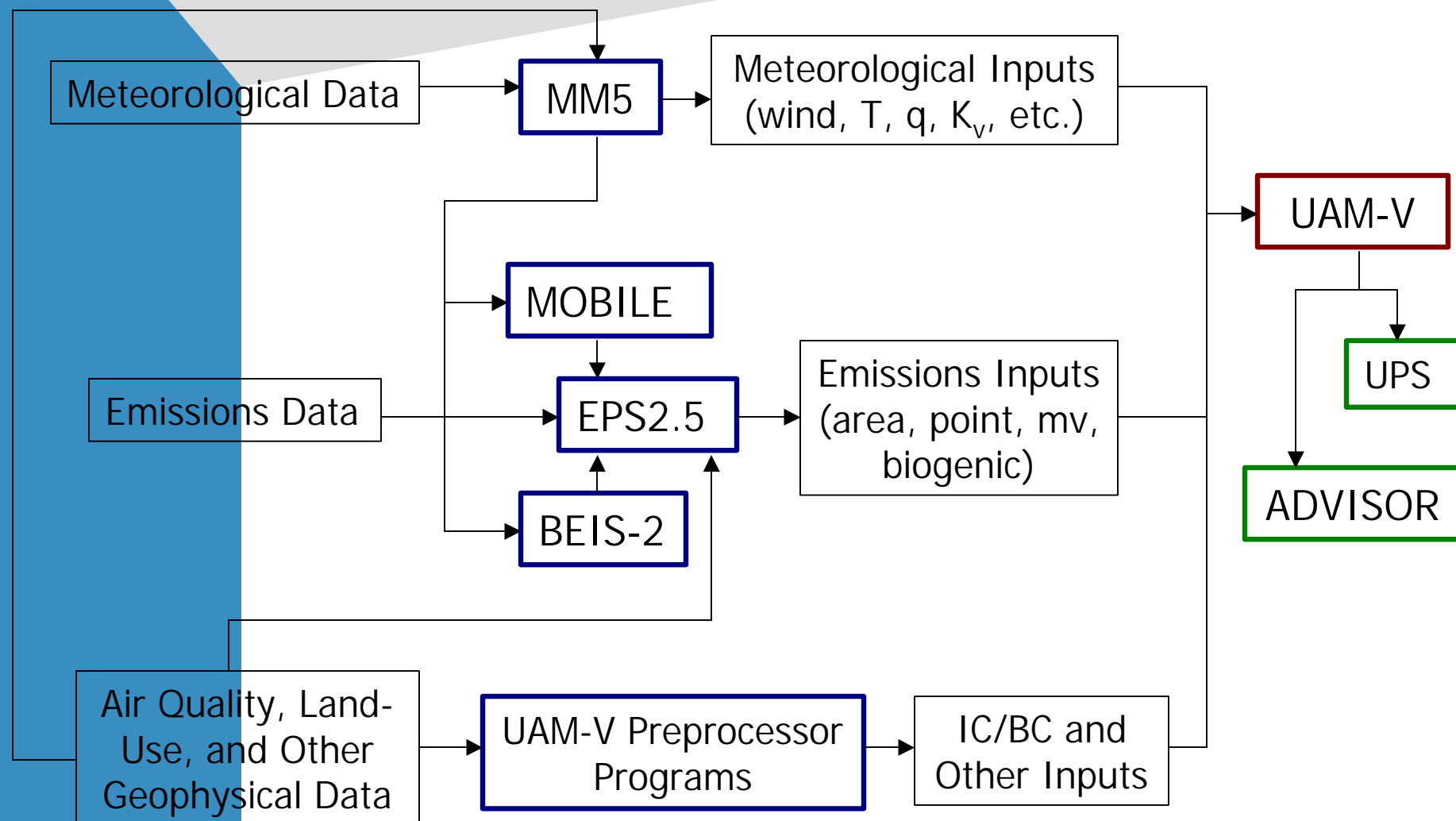
MAXIMUM 8-HOUR OZONE (PPB): KNOXVILLE/GSM AREA

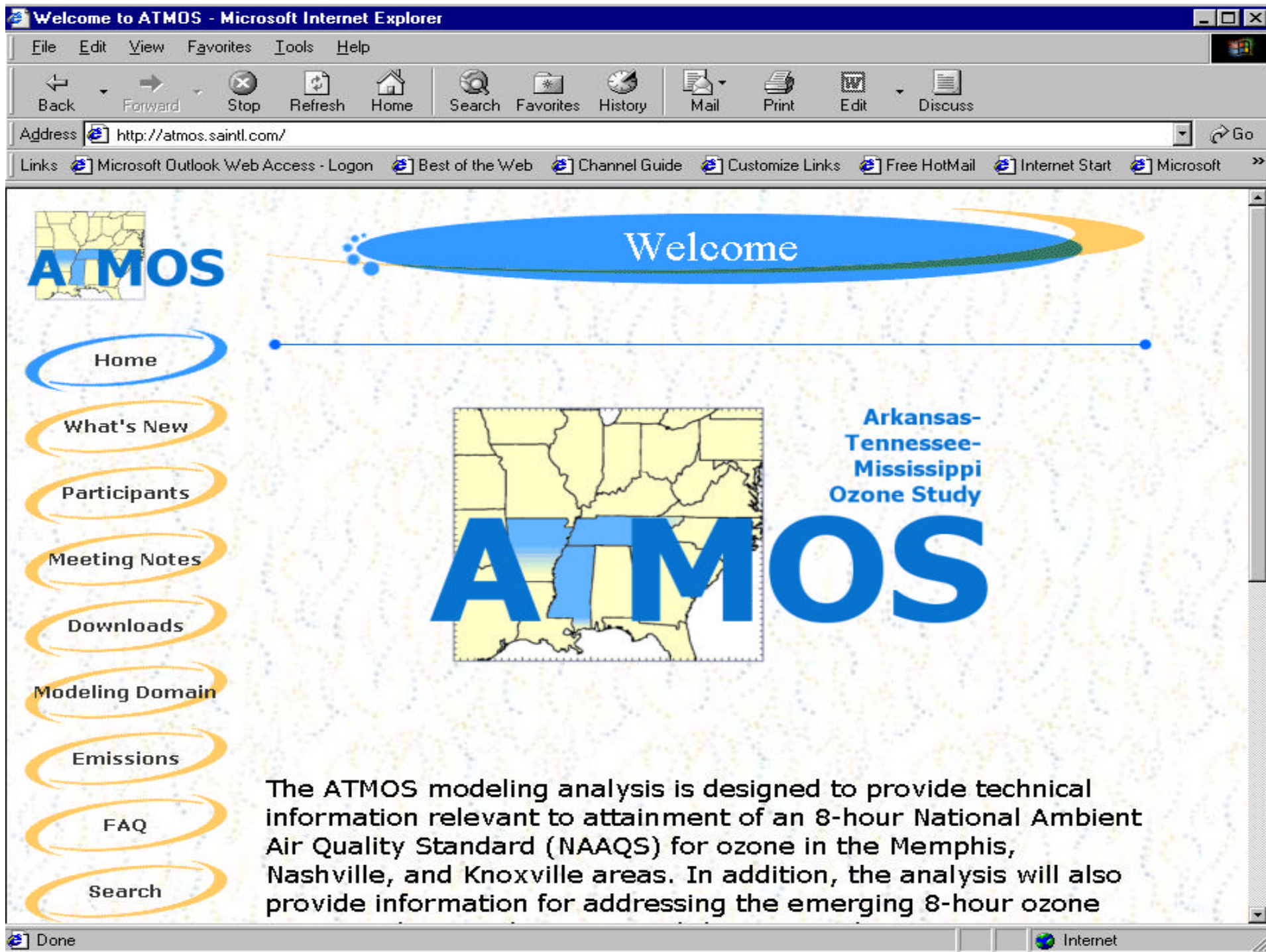


MAXIMUM 8-HOUR OZONE (PPB): CHATTANOOGA



ATMOS MODELING TOOLS AND PROCEDURES





ATMOS MODELING COMPONENTS COMPLETED TO DATE

- Episode selection
- Base-case emission inventory and meteorological input preparation
- Model performance evaluation
- Future-year (2010) baseline emission inventory preparation
- 2010 baseline and “A-list” emission-reduction sensitivity simulations; ADVISOR tool preparation

ATMOS EAC MODELING ANALYSIS: NEXT STEPS

- Develop 2007 emission inventory
- Update ADVISOR to include additional areas of interest within TN
- Run 2007 baseline simulation and incorporate results into ADVISOR
- Evaluate simulated baseline concentration fields and estimated design values (ADVISOR)
- Identify local/state/regional control strategies

ATMOS EAC MODELING ANALYSIS: NEXT STEPS

- Re-run model for selected measures or packages of measures (iterative)
- Complete attainment demonstration following EPA's draft 8-hour modeling guidance
- Conduct future attainment maintenance analysis – assess growth by modeling 2012

DEVELOPMENT OF THE 2007 EAC FUTURE-YEAR EMISSION INVENTORY

- Information/data to be used
 - Growth factors (BEA/EGAS)
 - Plant start-ups/shutdowns
 - Point and area source control information - EPA
 - Estimates for large sources (e.g. utilities)
 - Future-year VMT/MOBILE6 Inputs
 - SIP control emissions for Birmingham, Atlanta, Baton Rouge, East Texas

ATMOS/EAC FUTURE-YEAR (2007) EMISSIONS COMPONENTS

- Point and area sources
 - Project emissions using growth factors
 - Impose controls on certain sources/source categories
 - Incorporate startups/shutdowns
- Mobile sources
 - Obtain future-year VMT/fleet mix estimates
 - Use MOBILE6 to provide emissions
- Non-road sources
 - Run EPA NONROAD model

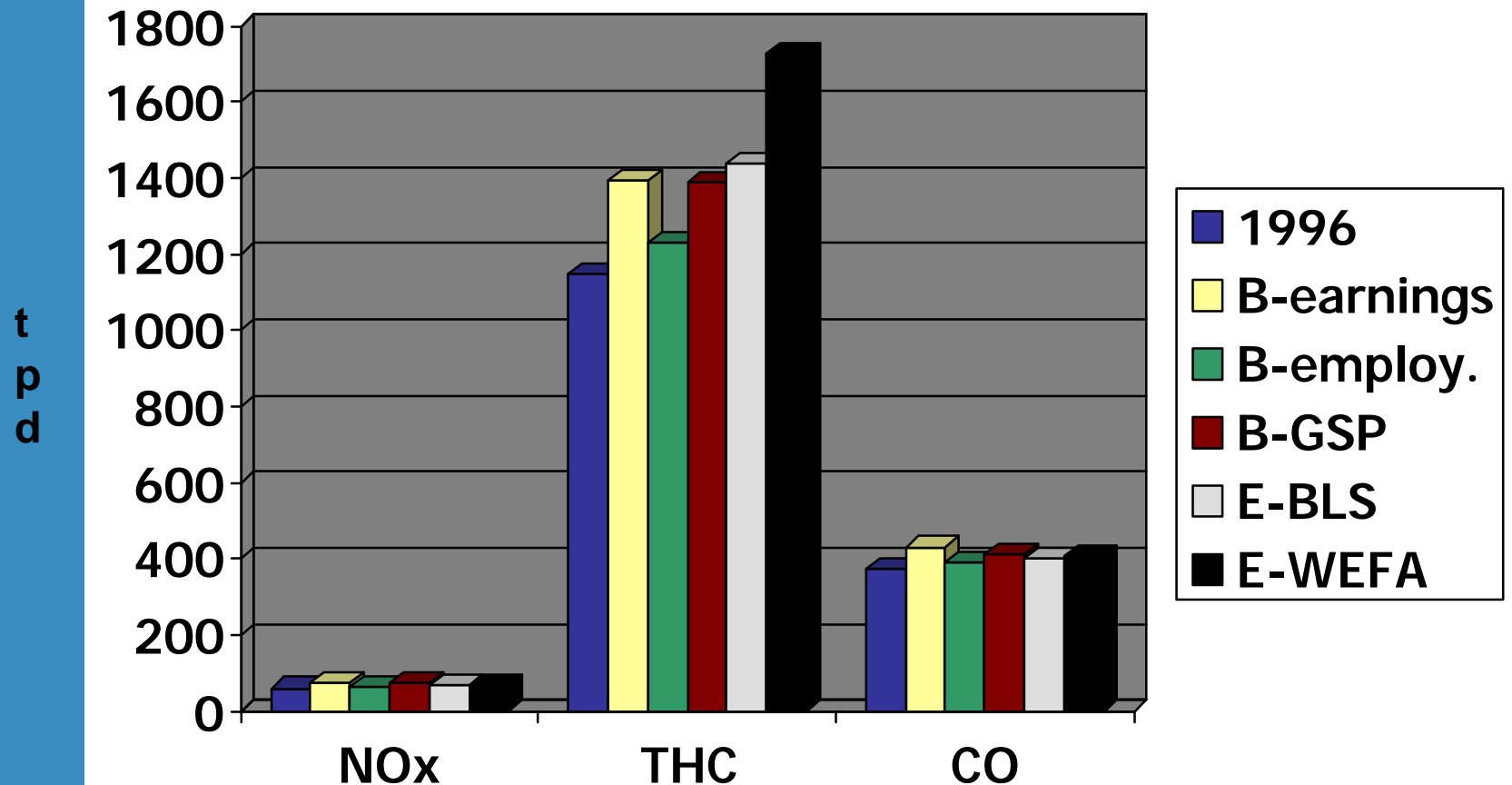
BUREAU OF ECONOMIC ANALYSIS (BEA) GROWTH FACTORS

- Factors based on state-level earnings, employment, and gross state product data
- Available for selected years through 2045
- 2-digit SIC code for point sources
- 4-digit ASC code for area sources
- Last published in 1995

AREA SOURCES FOR ATMOS/EAC 2007

- Apply BEA GSP factors
- Apply energy adjustments for fuel combustion sources (from EPA/DOE)
- Include Federal controls: Title III MACT and Title I RACT
- Impose controls for residential wood combustion and Stage II vapor recovery

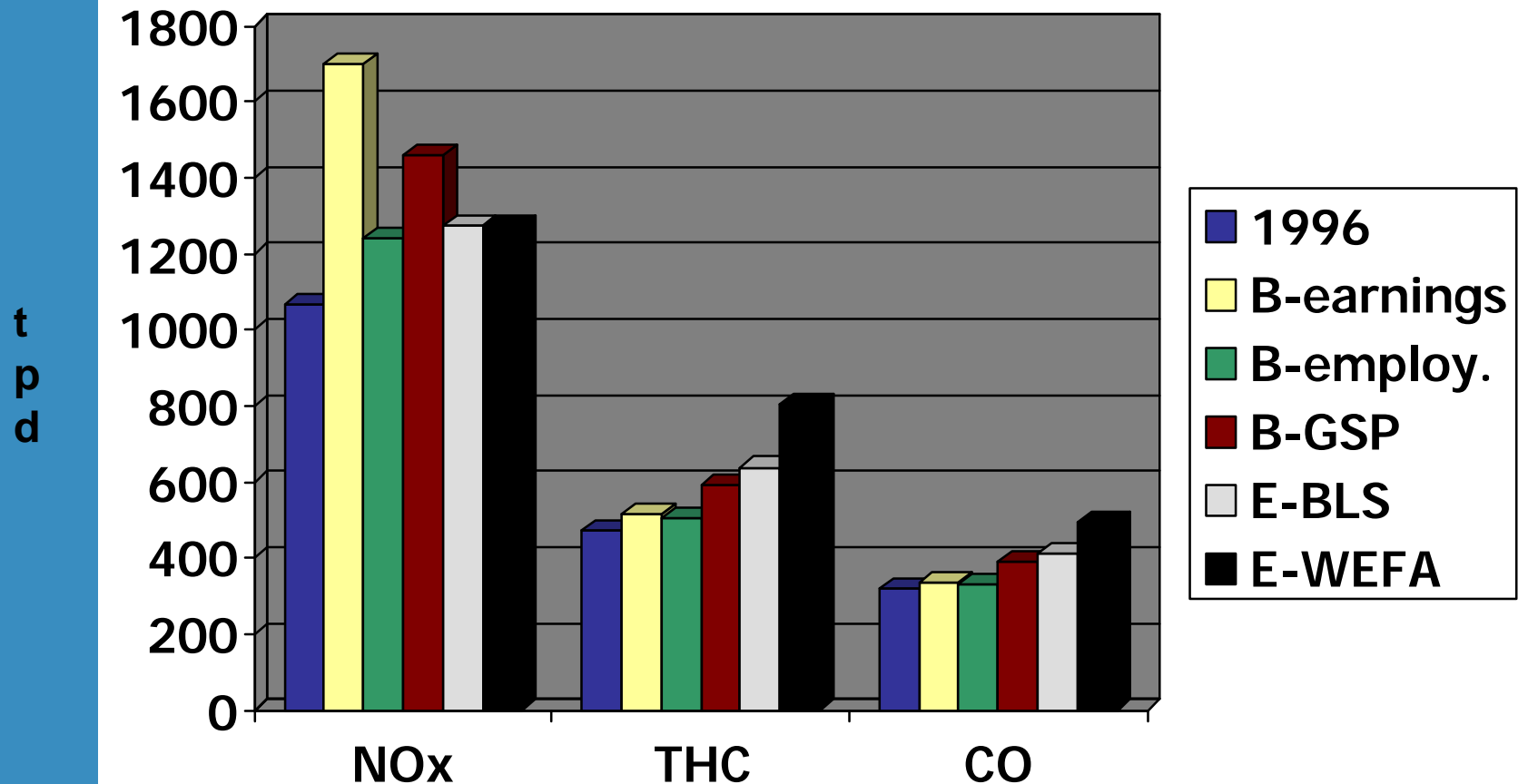
COMPARISON OF 2010 TENNESSEE AREA SOURCE EMISSIONS USING BEA AND EGAS GROWTH FACTORS



POINT SOURCES FOR ATMOS/EAC 2007

- Apply BEA GSP factor
- Apply energy adjustment for non-EGU fuel combustion sources (from EPA/DOE)
- Apply NOx SIP Call controls to EGU and non-EGU sources
- Apply CAA baseline control and MACT control assumptions
- Use specific emission estimates for TVA and Southern Company sources

COMPARISON OF 2010 TENNESSEE POINT SOURCE EMISSIONS USING BEA AND EGAS GROWTH FACTORS



ATMOS/EAC 2007 MOBILE SOURCE EMISSIONS

- Use 2007 county-level VMT and MOBILE6 inputs for TN (received from UT)
- Use 2007 county-level VMT for AR, AL, GA, NC, SC
- Use 2007 state-level VMT provided by FHWA for all other states

ATMOS/EAC 2007

MOBILE SOURCE EMISSIONS

- Will include federal rules
 - NLEV (2001)
 - NOx standard for Heavy Duty Diesel Vehicles (HDDV) (2004)
 - Tier 2 vehicle/fuel sulfur standards (2004 – 2006)
 - Diesel fuel sulfur standards (2006)

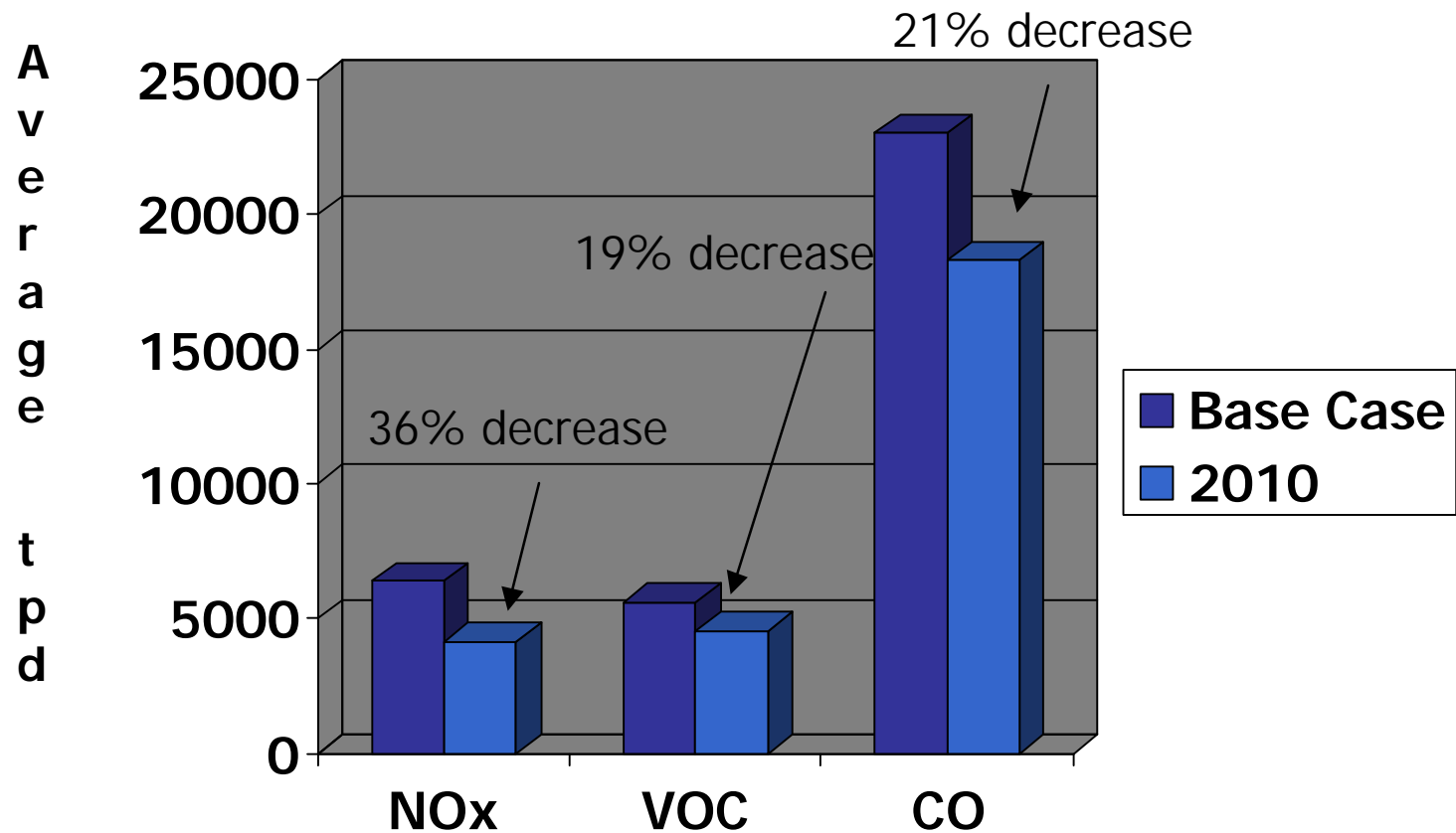
ATMOS/EAC 2007 NON-ROAD SOURCES

- Use EPA NONROAD2002 model
- Use BEA GSP projection factors for Aircraft, Railroad, and Commercial Marine Vessels

ATMOS/EAC 2007 BASELINE EMISSIONS WILL INCLUDE:

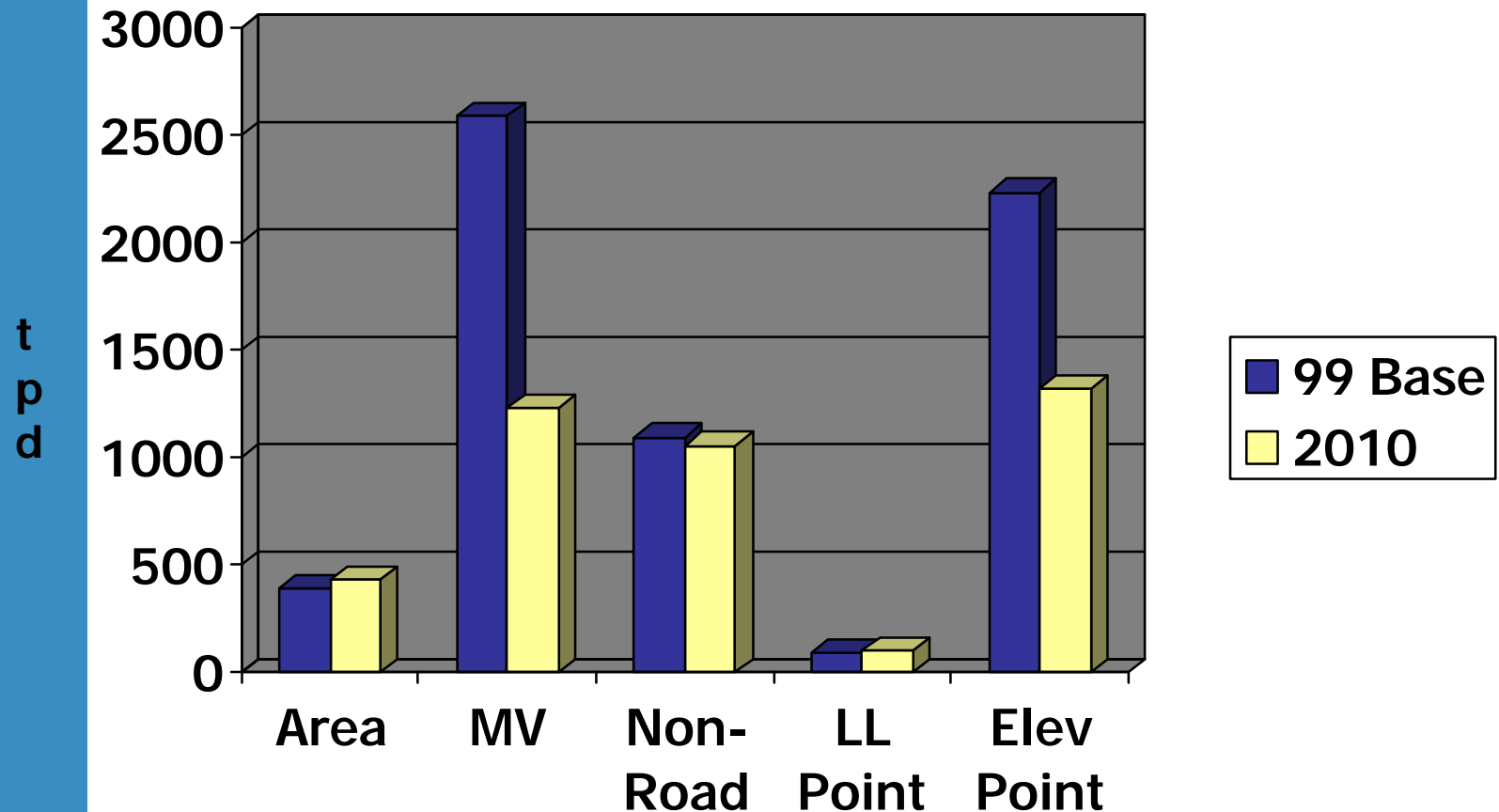
- Atlanta 2003 SIP information
 - I&M, low sulfur fuel
 - Georgia Power reductions
 - Ban on open burning (45 counties)
- Birmingham 1999 SIP
 - Low sulfur fuel
- Baton Rouge 2005 SIP
 - NO_x RACT controls
- East Texas 2007 SIP (Houston, Beaumont/Port Arthur)

COMPARISON OF ANTHROPOGENIC EMISSIONS FOR GRID 3: 1999 BASE CASE AND 2010 BASELINE

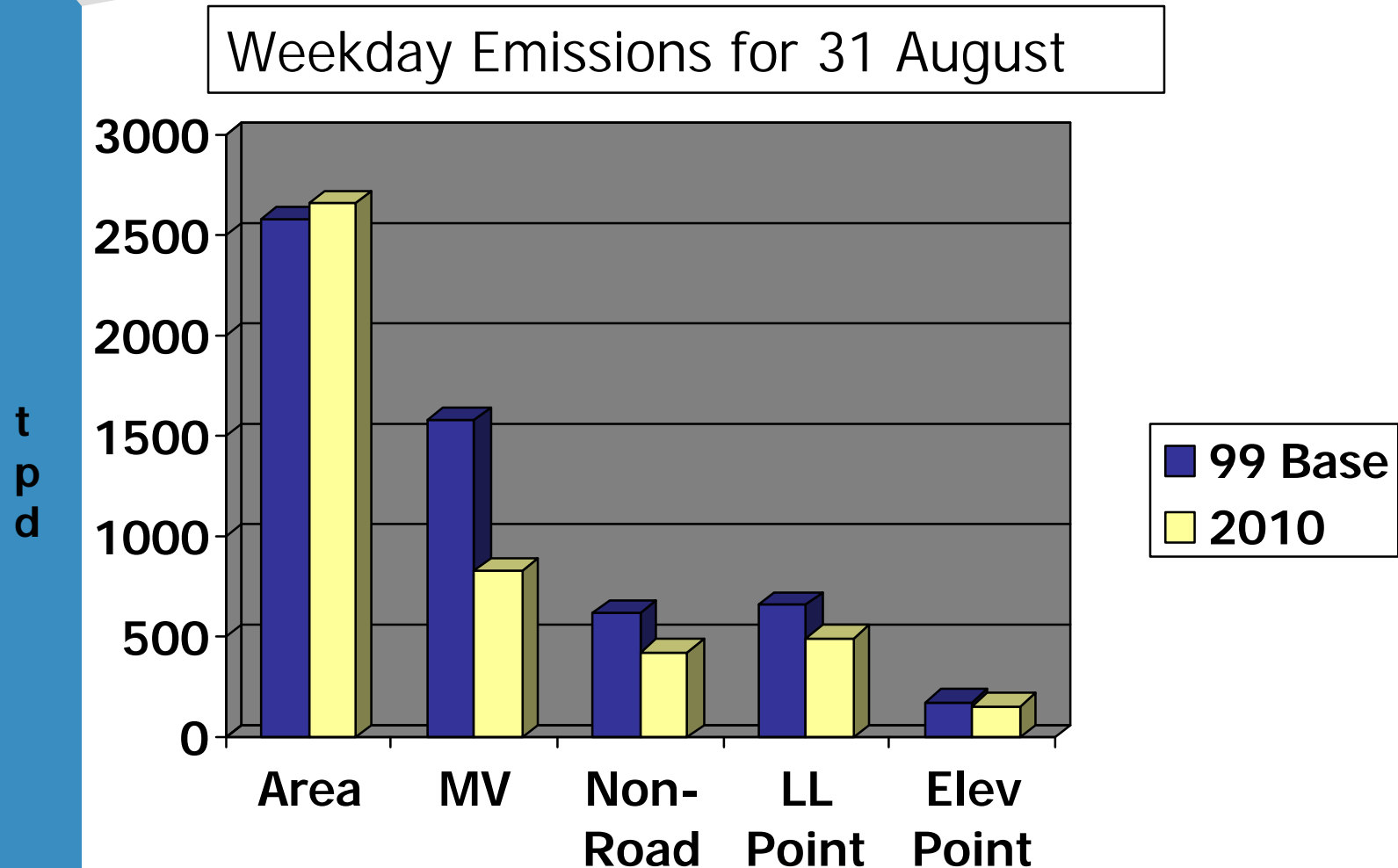


COMPARISON OF NOX EMISSIONS BY COMPONENT FOR ATMOS GRID 3

Weekday Emissions for 31 August

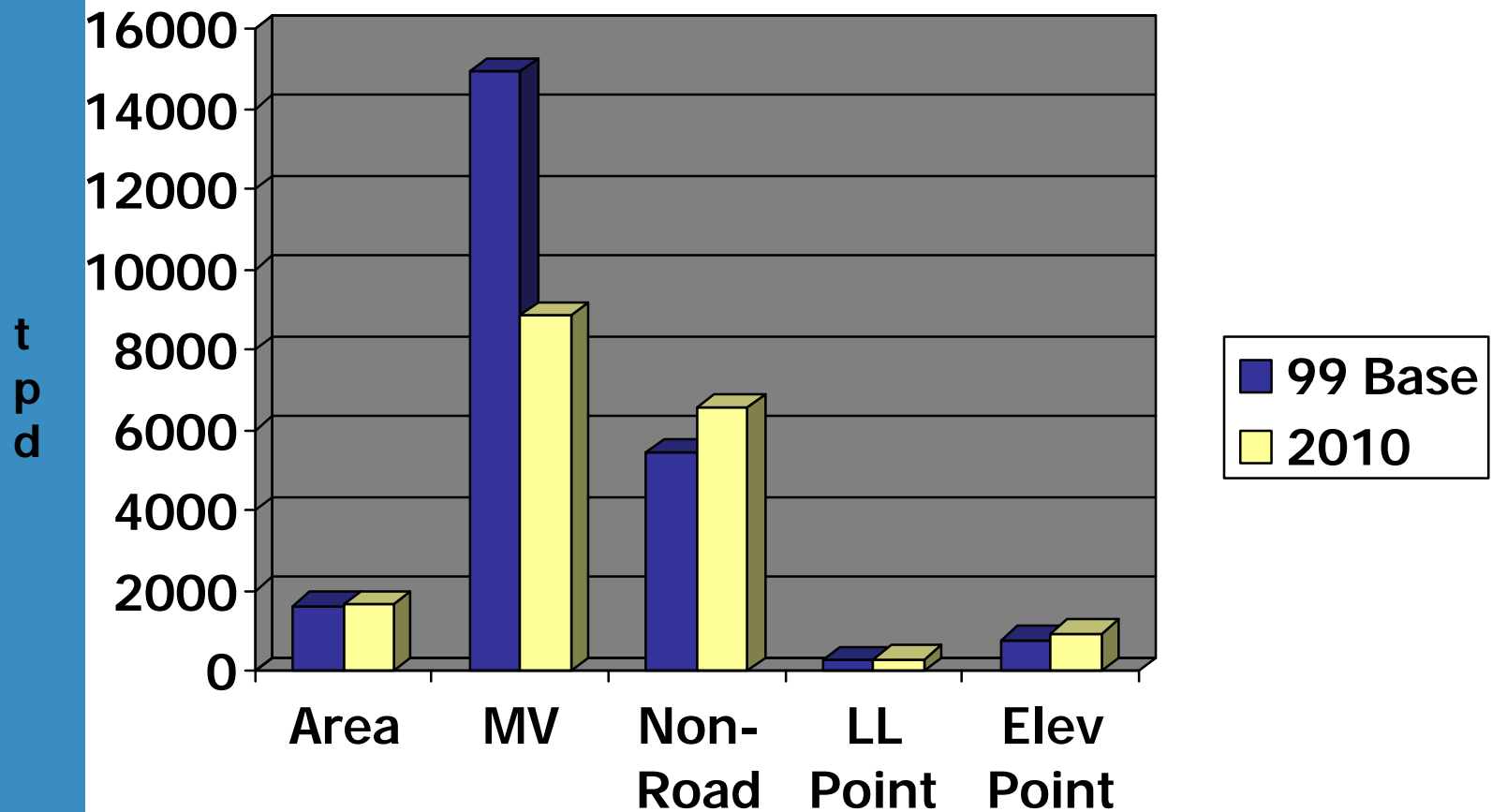


COMPARISON OF VOC EMISSIONS BY COMPONENT FOR ATMOS GRID 3

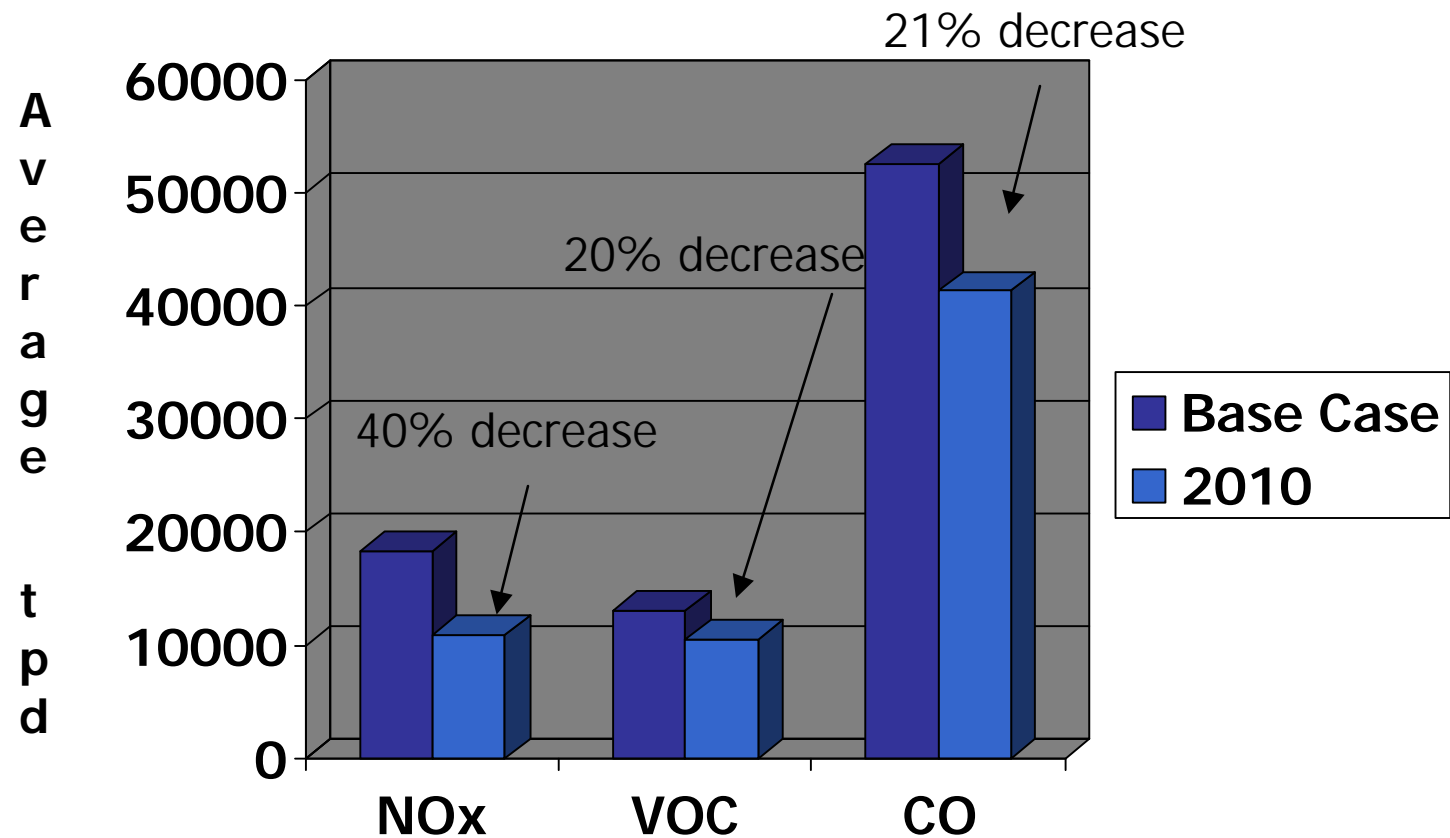


COMPARISON OF CO EMISSIONS BY COMPONENT FOR ATMOS GRID 3

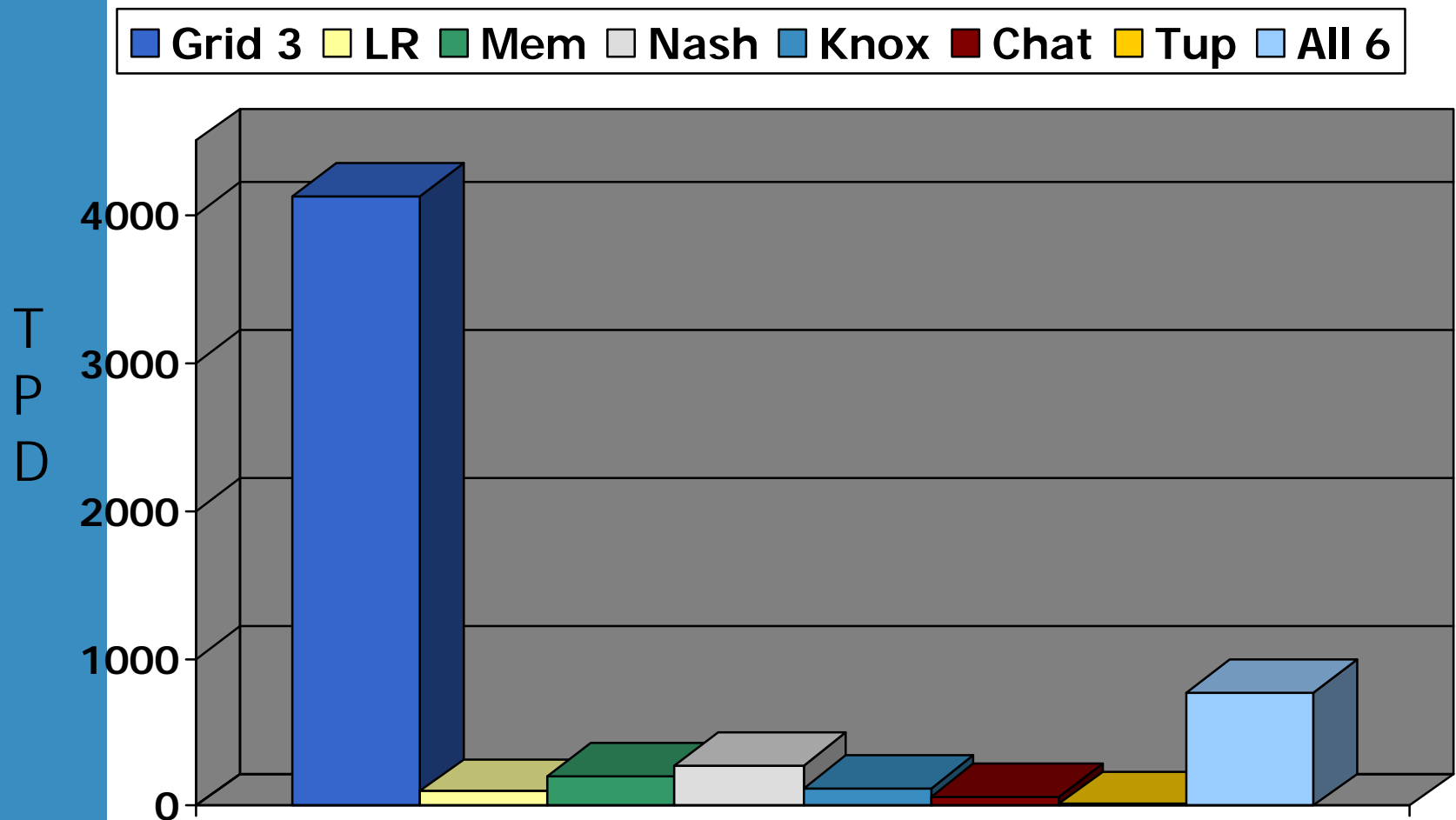
Weekday Emissions for 31 August



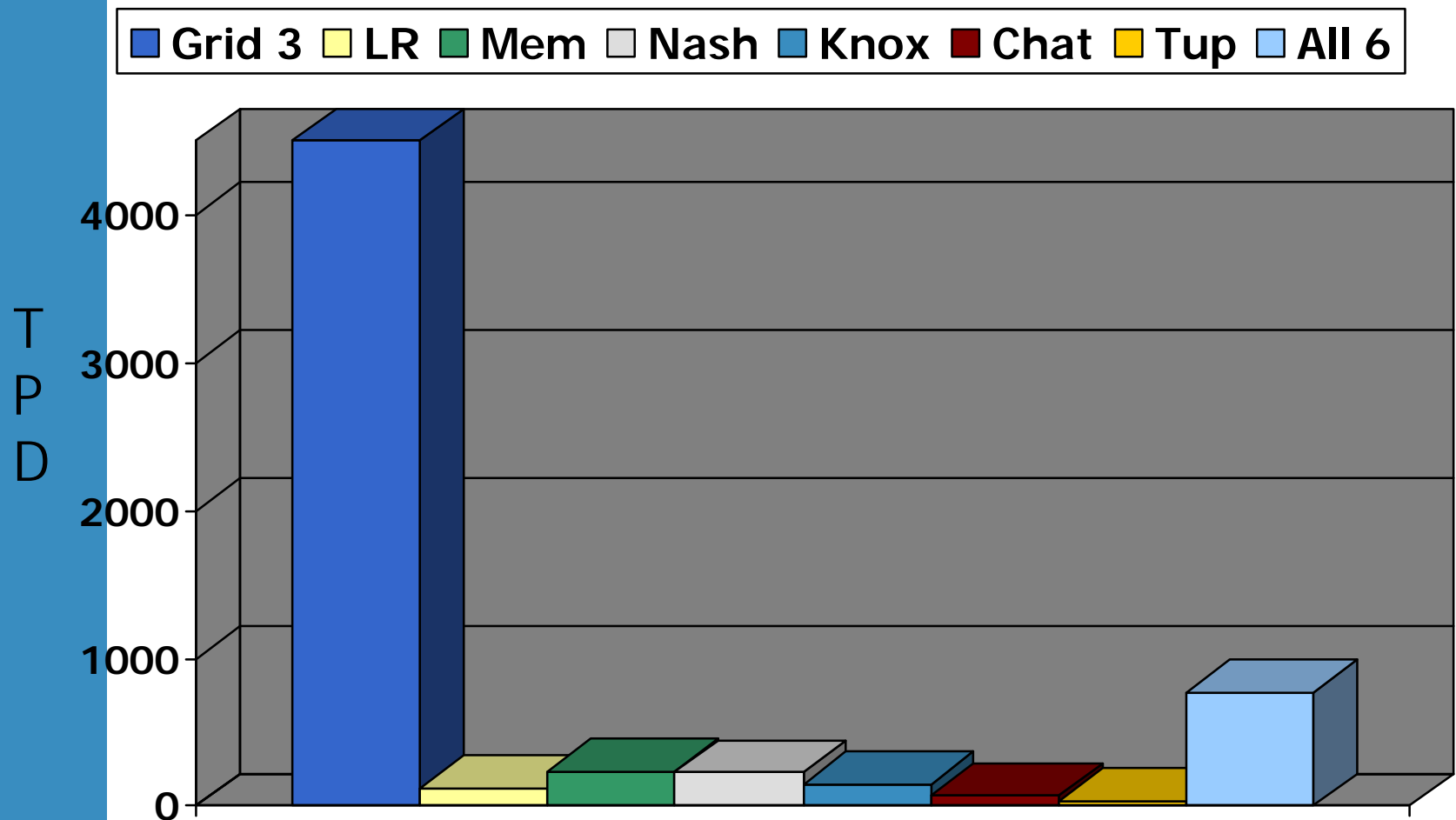
COMPARISON OF ANTHROPOGENIC EMISSIONS FOR GRID 2: 1999 BASE CASE AND 2010 BASELINE



COMPARISON OF 2010 EMISSIONS BY AREA: ANTHROPOGENIC NO_x



COMPARISON OF 2010 EMISSIONS BY AREA: ANTHROPOGENIC VOC





OVERVIEW OF ADVISOR

ADVISOR SIMULATION ANALYSIS TOOL FOR UAM-V

- What is ADVISOR?
 - ACCESS Database for Visualizing and Identifying Strategies for Ozone Reduction (ADVISOR)
- ADVISOR functionality
 - detailed analysis of simulation results by domain, subregion, site, etc.
 - comparative analysis of emission-reduction simulation results
 - application of 8-hour attainment demonstration procedures

ADVISOR SIMULATION ANALYSIS TOOL FOR UAM-V

- ADVISOR metrics
 - 1-hour ozone peak and exposure metrics
 - 8-hour ozone peak and exposure metrics
 - emissions
- ADVISOR “geographies” for ATMOS
 - UAM-V Grids 1, 2, and 3
 - Single and multi-county areas of interest (see next slide)
 - Ozone monitoring sites in Grid 3

CURRENT ADVISOR "GEOGRAPHIES" FOR TENNESSEE

- Memphis
 - Shelby, DeSoto, and Crittenden Counties (Memphis area)
 - Shelby County, TN (Memphis)
 - DeSoto County, MS
 - Crittenden County, AR
- Nashville
 - Sumner, Davidson, Wilson, Rutherford and Williamson Counties, TN (Nashville area)
 - Davidson County, TN (Nashville)
 - Sumner, Wilson, and Rutherford Counties, TN

CURRENT ADVISOR "GEOGRAPHIES" FOR TENNESSEE

- Knoxville
 - Knox, Anderson, Jefferson, Sevier, and Blount Counties, TN (Knoxville area)
 - Knox County, TN (Knoxville)
 - Knox, Anderson, and Jefferson Counties, TN
 - Blount and Sevier Counties, TN

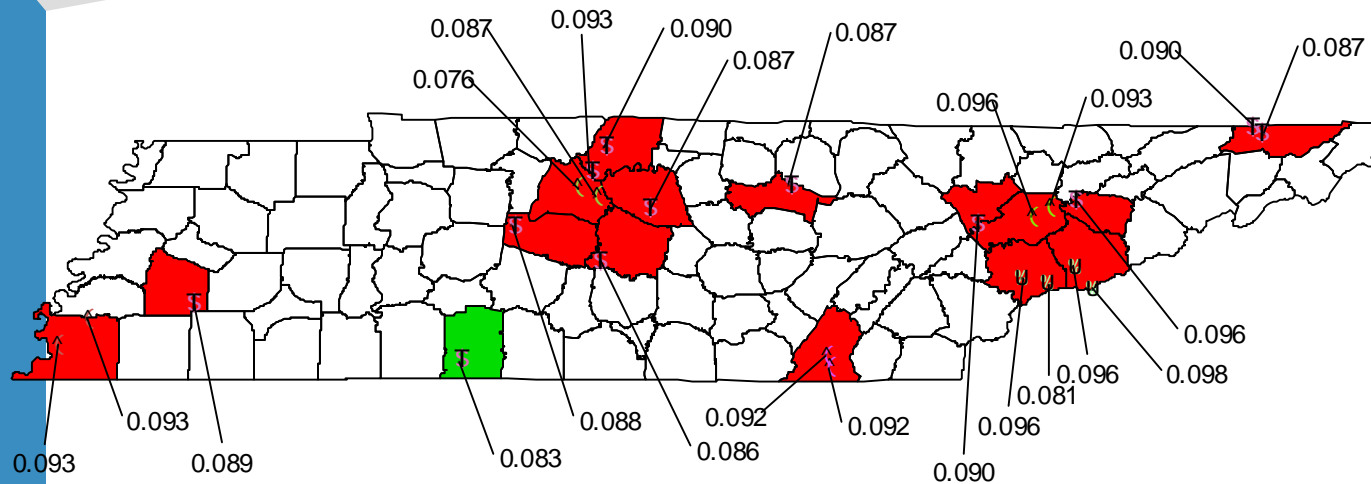
CURRENT ADVISOR "GEOGRAPHIES" FOR TENNESSEE

- Chattanooga
 - Hamilton, Walker, and Catoosa Counties (Chattanooga area)
 - Hamilton County, TN (Chattanooga)
 - Walker and Catoosa Counties, GA
 - Walker County, GA
 - Catoosa County, GA
- Other TN
 - Haywood County, TN

NEW ADDITIONS TO ADVISOR "GEOGRAPHIES" FOR TENNESSEE

- Other TN
 - Lawrence County, TN
 - Meigs County, TN
 - Putnam County, TN
 - Sullivan County, TN
 - Neighboring counties to these?
 - Established MSAs?
 - Other areas of interest?

Tennessee 8 Hour Ozone Design Values 1999 - 2001



Monitoring Sites With 3 Years of Data

- ↗ Shelby Co. Sites
- ↘ Knox Co. Sites
- ↖ Hamilton Co. Sites
- ↗ Davidson Co. Sites
- U GSMNP Sites
- ⊞ Tennessee Sites

- 3 Years Data > 0.084 PPM (Violating Standard)
- 3 Years Data < 0.085 PPM (Attaining Standard)

8 Hour Tennessee Ozone Design Values By MSA 1999 - 2001

The map displays the following Metropolitan Statistical Areas (MSAs) and their associated design values:

- Clarksville- Hopkinsville MSA: 0.076
- Nashville MSA: 0.093
- Knoxville MSA: 0.093
- Johnson City - Kingsport - Bristol MSA: 0.087
- Jackson MSA: 0.088
- Memphis MSA: 0.093
- Florence MSA: 0.083
- Huntsville MSA: 0.086
- Chattanooga MSA: 0.092
- Decatur MSA: 0.092
- Asheville MSA: 0.096

Design values for other areas shown on the map include:

- 0.087 (near Nashville)
- 0.090 (near Nashville)
- 0.087 (near Knoxville)
- 0.096 (near Knoxville)
- 0.090 (near Johnson City - Kingsport - Bristol)
- 0.087 (near Johnson City - Kingsport - Bristol)
- 0.096 (near Asheville)
- 0.090 (near Asheville)
- 0.096 (near Asheville)
- 0.098 (near Asheville)
- 0.081 (near Asheville)
- 0.096 (near Asheville)
- 0.090 (near Asheville)
- 0.092 (near Chattanooga)
- 0.092 (near Chattanooga)
- 0.086 (near Huntsville)
- 0.089 (near Jackson)
- 0.093 (near Jackson)
- 0.093 (near Memphis)

Notes:

- Design values in parts per million.
- Old 1-hr nonattainment areas in hatched areas.
- A county with a design value greater than or equal to 0.085 ppm is violating the standard.

Legend:

- NPS DV 1999 - 2001
- Shelby Co. DV 1999 - 2001
- Knox Co. DV 1999 - 2001
- Hamilton Co. DV 1999 - 2001
- Davidson Co. DV 1999 - 2001
- State APC DV 1999 - 2001

Surrounding States:

- Arkansas
- Mississippi
- Alabama
- Georgia
- North Carolina
- Virginia
- Kentucky

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Design values in parts per million.
Old 1-hr nonattainment areas in hatched areas.
A county with a design value greater than or
equal to 0.085 ppm is violating the standard.



CURRENT ADVISOR "GEOGRAPHIES" FOR OTHER STATES

- Tupelo
 - Lee County, MS (Tupelo)
- Little Rock
 - Pulaski, Saline, Lonoke, and Faulkner Counties, AR (Little Rock area)
 - Pulaski County, AR (Little Rock)
 - Jefferson County, AR
 - Pulaski, Saline, Lonoke, Faulkner, and Jefferson Counties, AR (expanded Little Rock area)

CURRENT ADVISOR “GEOGRAPHIES” FOR OTHER STATES

- Other metropolitan areas
 - Atlanta, GA
 - Birmingham, AL

KEY ADVISOR METRICS

- Simulated 8-hour maximum ozone concentration
 - for selected domain, subregion, or monitoring site
 - [ppb]
- 8-hour ozone exceedance exposure
 - measure of the “excess” concentration and number of grid cell hours greater than 85 ppb
 - for selected domain or subregion
 - [ppb·grid cells]

KEY ADVISOR METRICS

- Estimated design value (EDV)

$$\text{EDV} = \text{RRF} \cdot \text{DV}$$

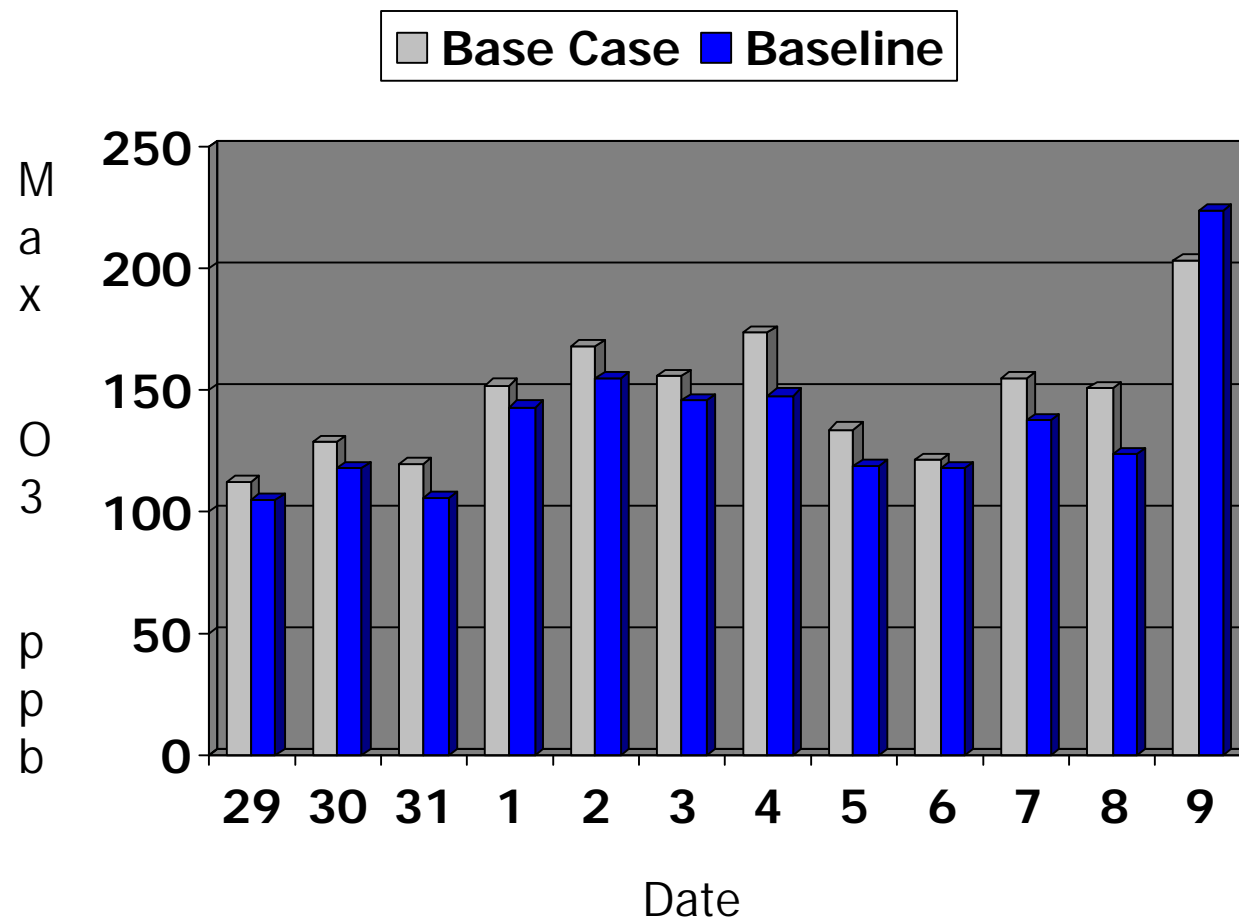
- RRF is the ratio of future-year scenario to base-year 8-hour ozone concentration in the vicinity of a monitoring site location
- DV is observation-based, current-year design value
- for selected monitoring site
- [ppb]

EPA attainment test requires EDV to be ≤ 84 ppb

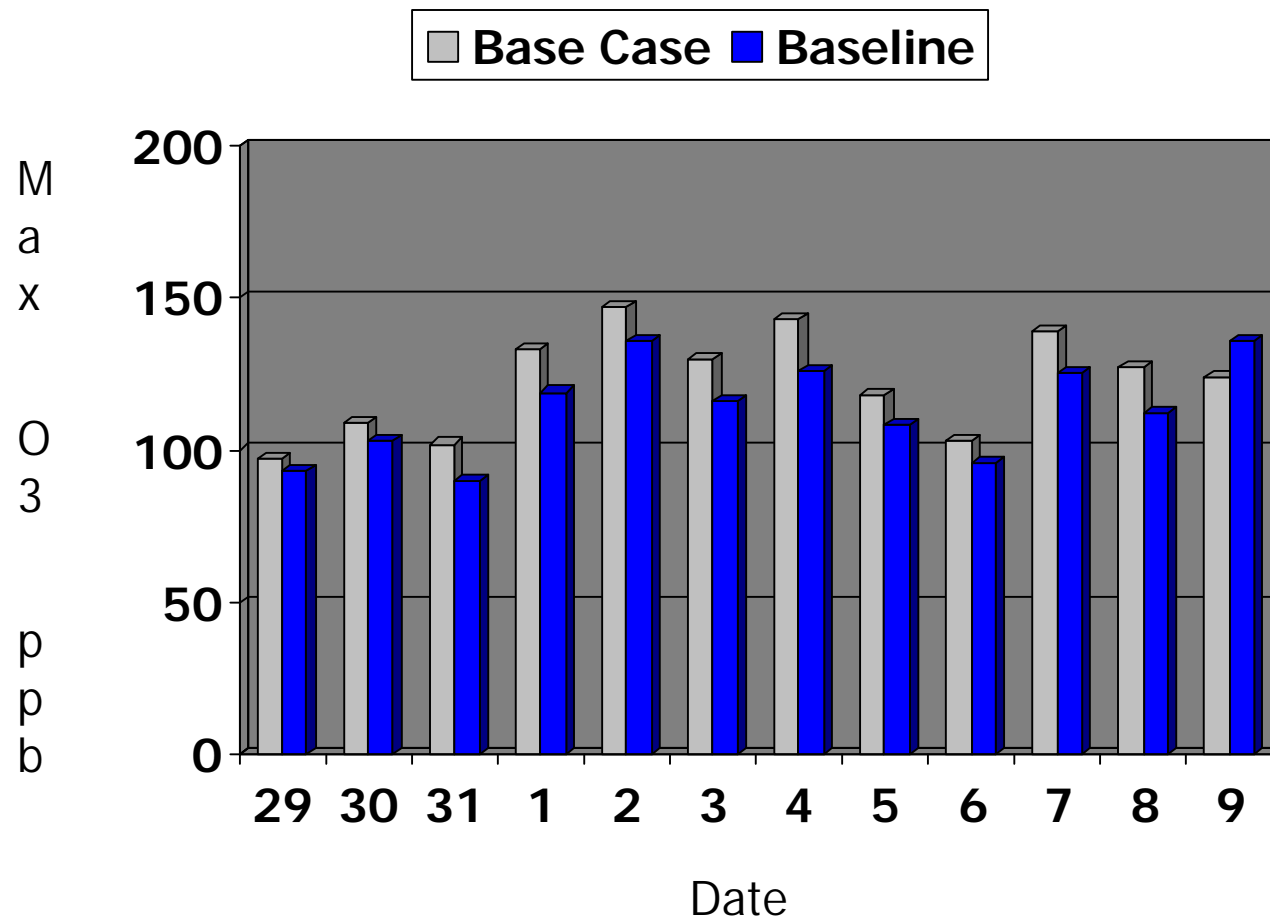
FUTURE-YEAR BASELINE RESULTS

- Relative to the base-case simulation, the 2010 baseline simulation shows mostly decreases in the maximum simulated ozone concentration with isolated areas of increase
- Differences (magnitude and patterns) vary from day to day
- 8-hour ozone exceedance exposure is reduced by 75% across all areas of interest
- EDVs for 2010 are generally 5-10 ppb lower than the base year DVs

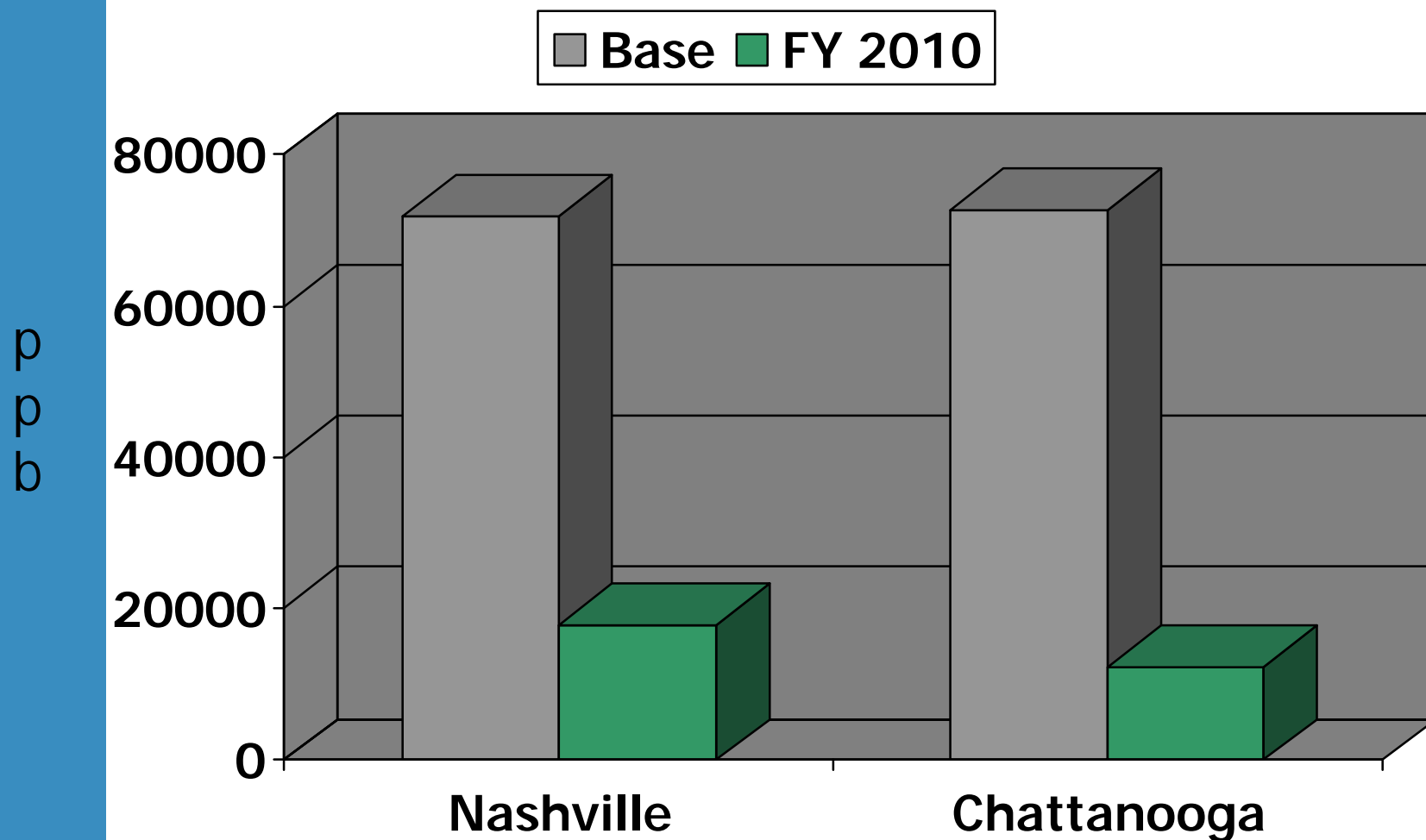
MAXIMUM SIMULATED 1-HR OZONE: BASE-CASE & 2010 BASELINE SIMULATIONS (GRID 3)



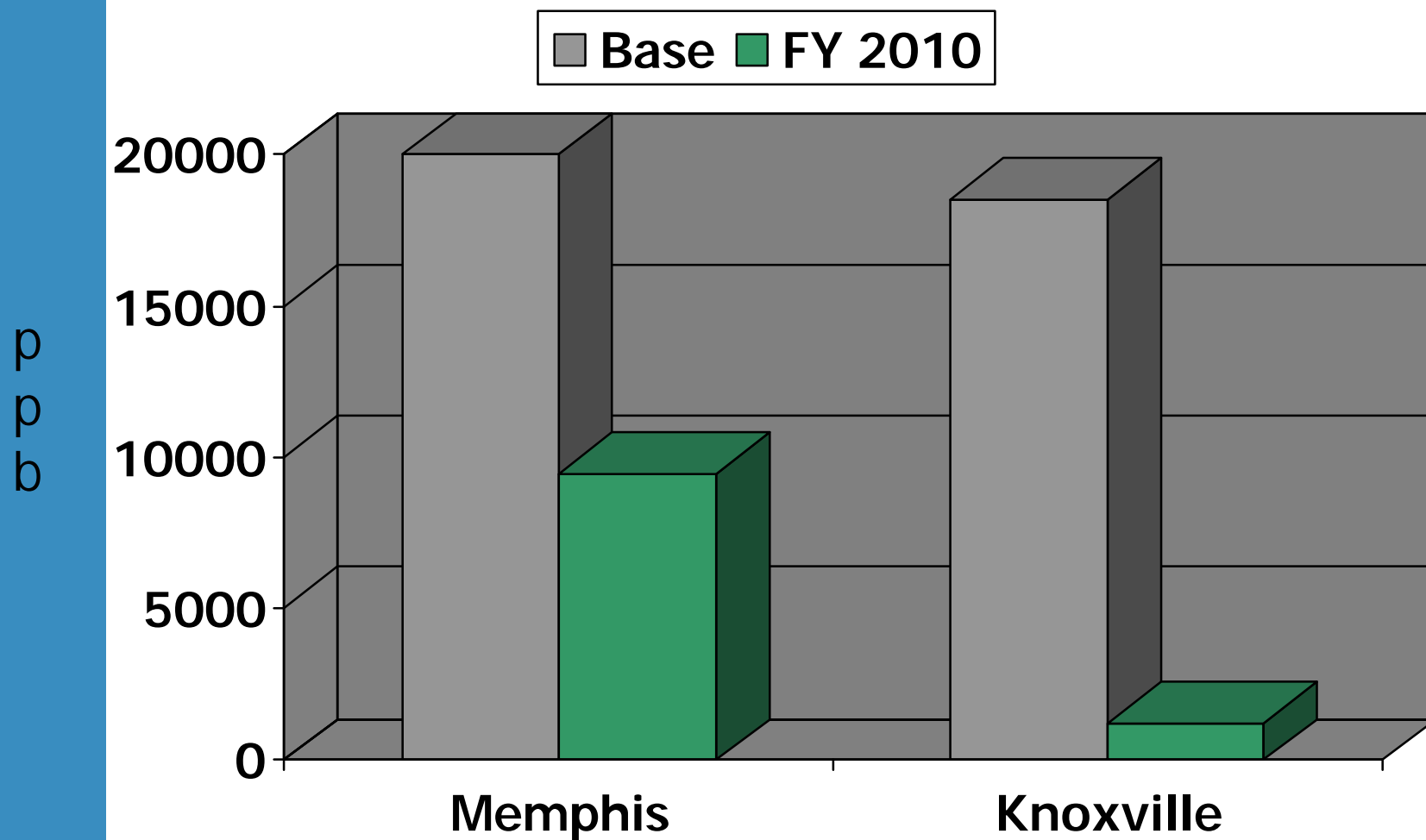
MAXIMUM SIMULATED 8-HR OZONE: BASE-CASE & 2010 BASELINE SIMULATIONS (GRID 3)



COMPARISON OF SIMULATED 8-HR OZONE EXCEEDANCE EXPOSURE



COMPARISON OF SIMULATED 8-HR OZONE EXCEEDANCE EXPOSURE





ADVISOR ANALYSIS OF BASE- CASE AND 2010 BASELINE SCENARIOS

ATMOS “A LIST” EMISSION-SENSITIVITY SIMULATIONS

Issue: Contribution from other (non-ATMOS) states

- **A1:** Zero out anthropogenic emissions from all states except TN, MS, and AR

ATMOS “A LIST” EMISSION-SENSITIVITY SIMULATIONS

Issue: Response to VOC vs. NO_x in areas of interest

- **A2:** 20% reduction in NO_x
- **A3:** 20% reduction in VOC
- **A4:** 20% reduction in NO_x and VOC

Notes: Anthropogenic emissions only; all six areas of interest (together; potential non-attainment counties only)

ATMOS “A LIST” EMISSION-SENSITIVITY SIMULATIONS

Issue: Effects of elevated vs. low-level NO_x reductions

- **A5:** 20% reduction in low-level NO_x
- **A6:** 20% reduction in elevated NO_x

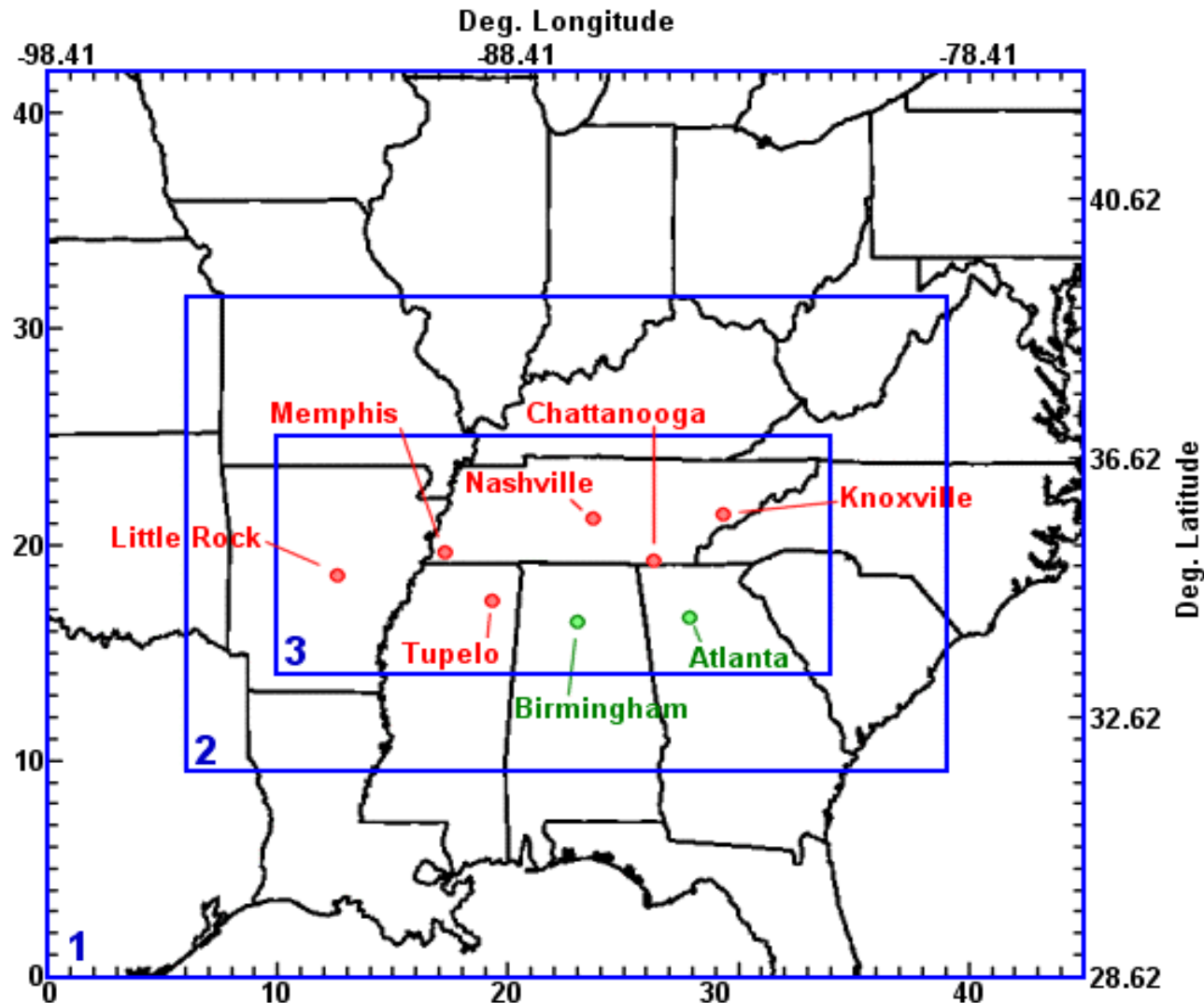
Notes: anthropogenic NO_x only; in TN and portions of AR and MS that are in Grid 3

ATMOS “A LIST” EMISSION-SENSITIVITY SIMULATIONS

Issue: Response to local vs. regional emissions reductions (when compared to A4)

- **A7:** 20% reduction in anthropogenic NO_x and VOC in TN and portions of AR and MS that are in Grid 3

ATMOS UAM-V MODELING DOMAIN



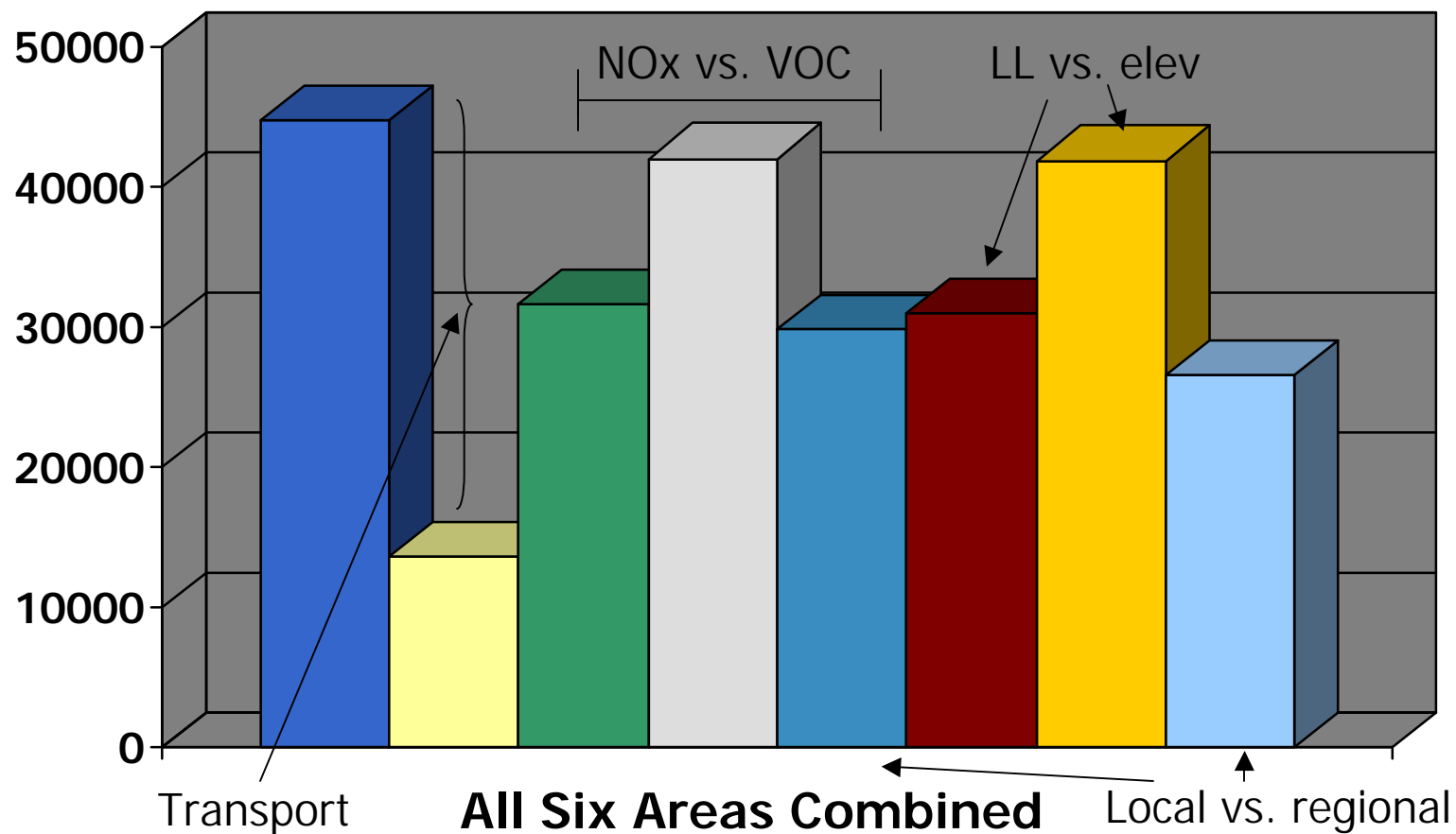
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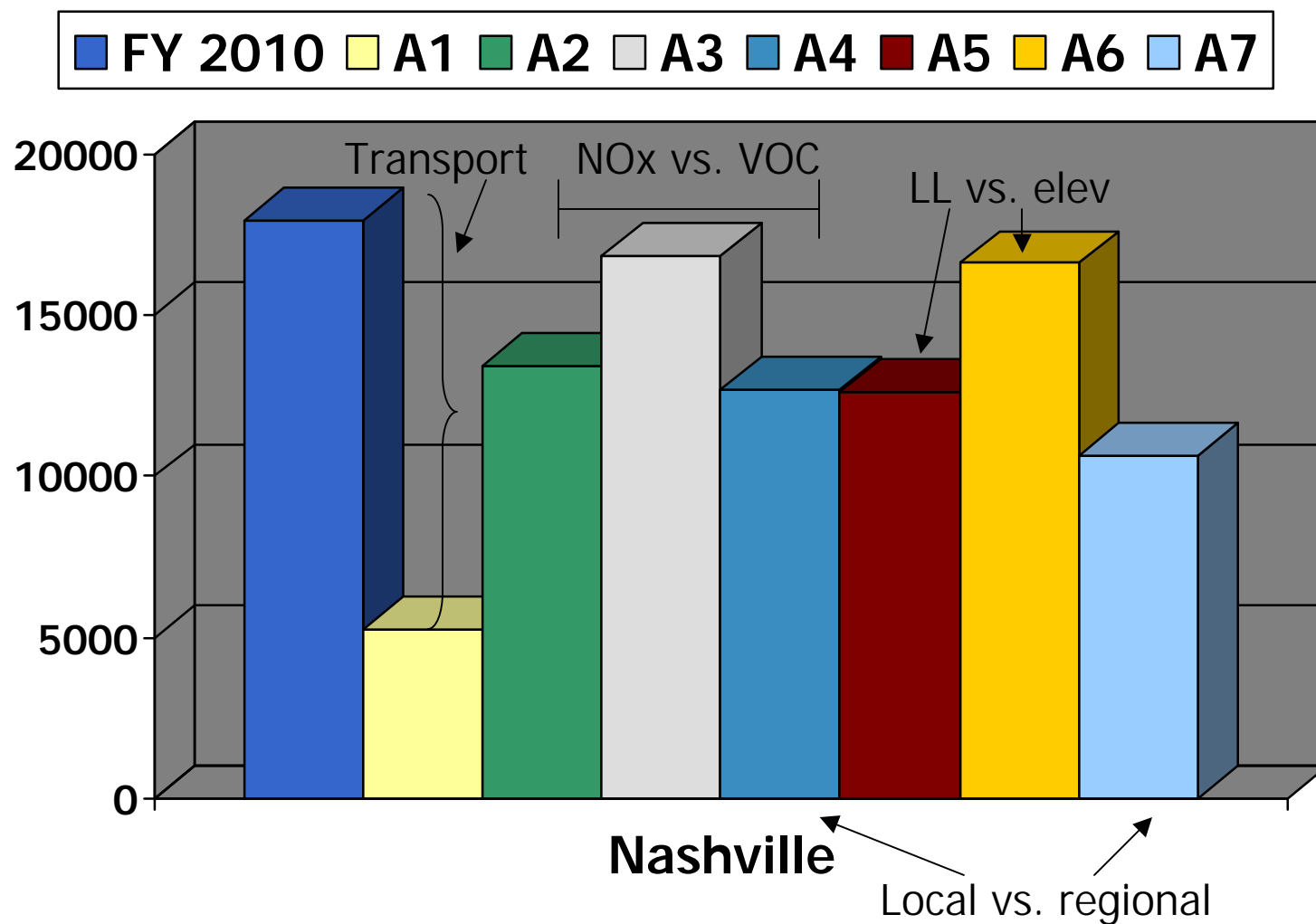
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COMPARISON OF SIMULATED 8-HR OZONE EXCEEDANCE EXPOSURE

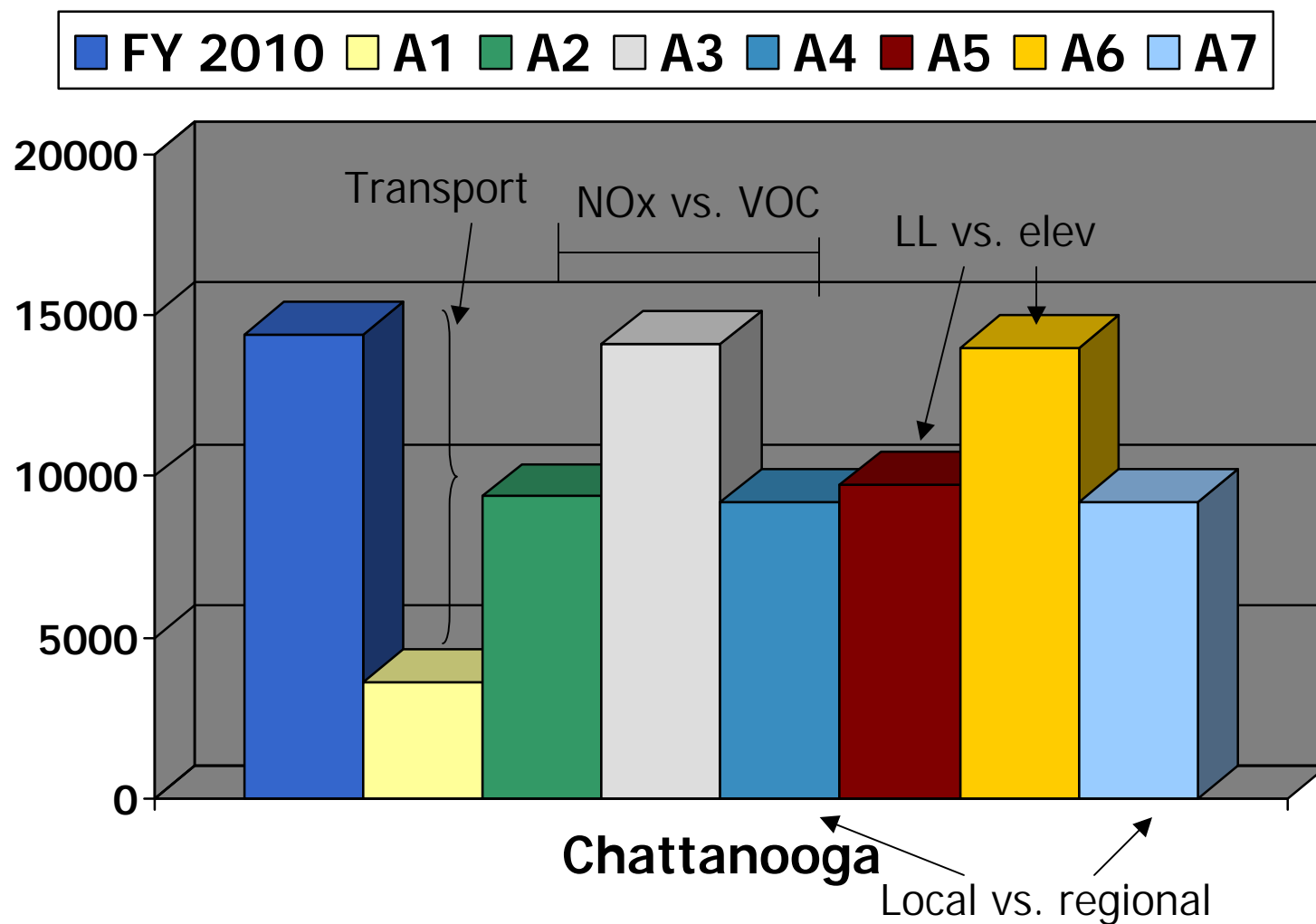
■ FY 2010 ■ A1 ■ A2 ■ A3 ■ A4 ■ A5 ■ A6 ■ A7



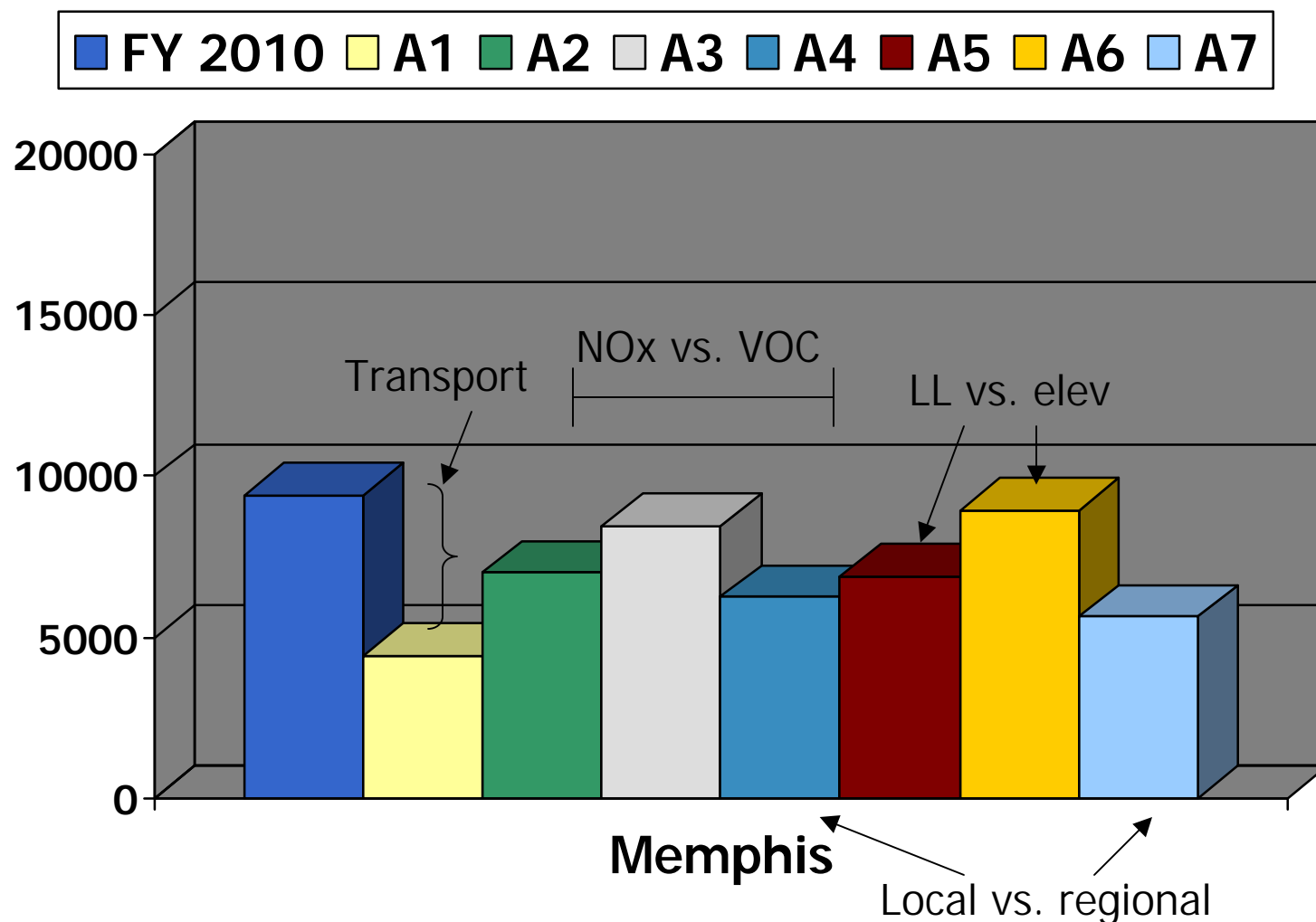
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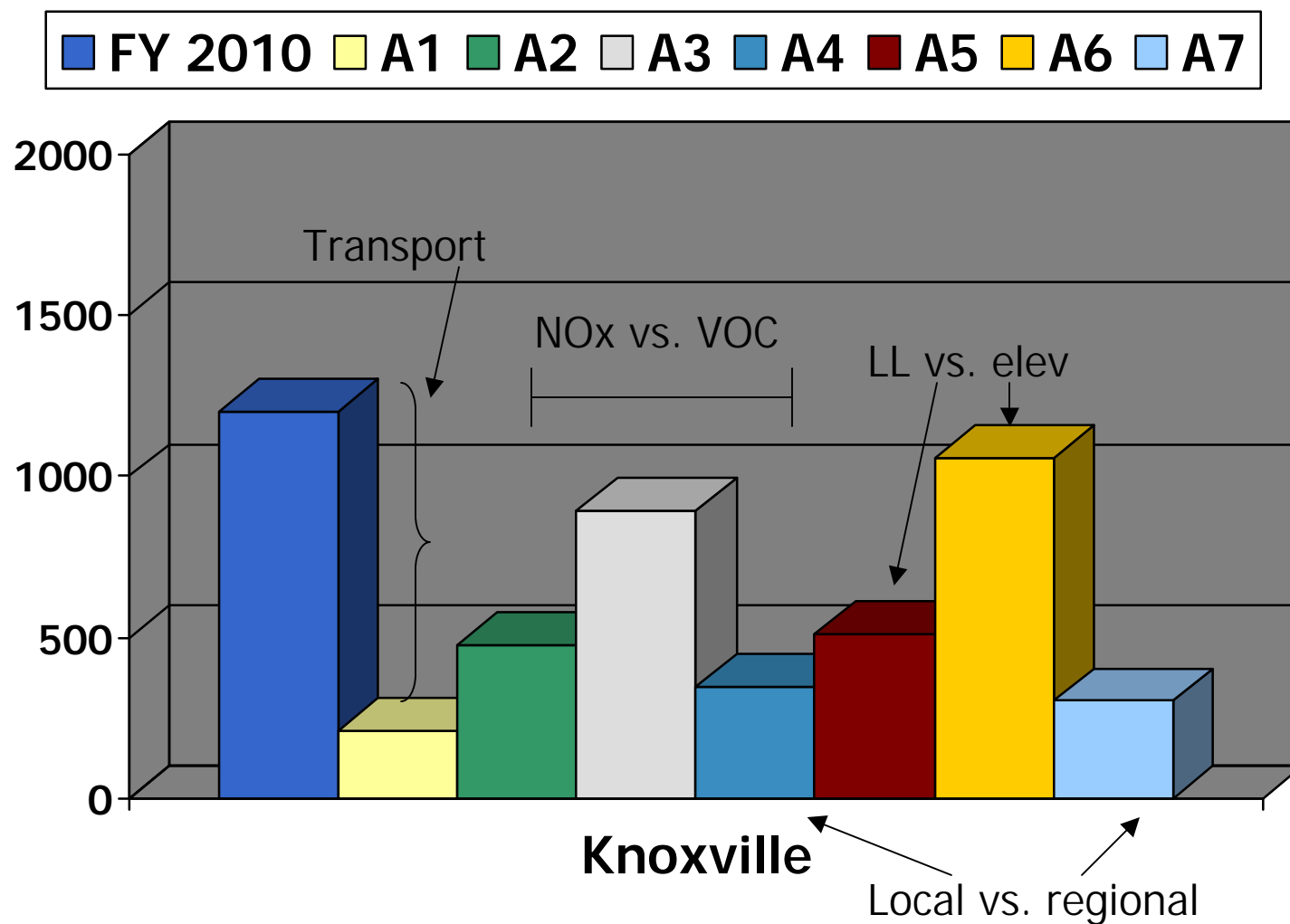
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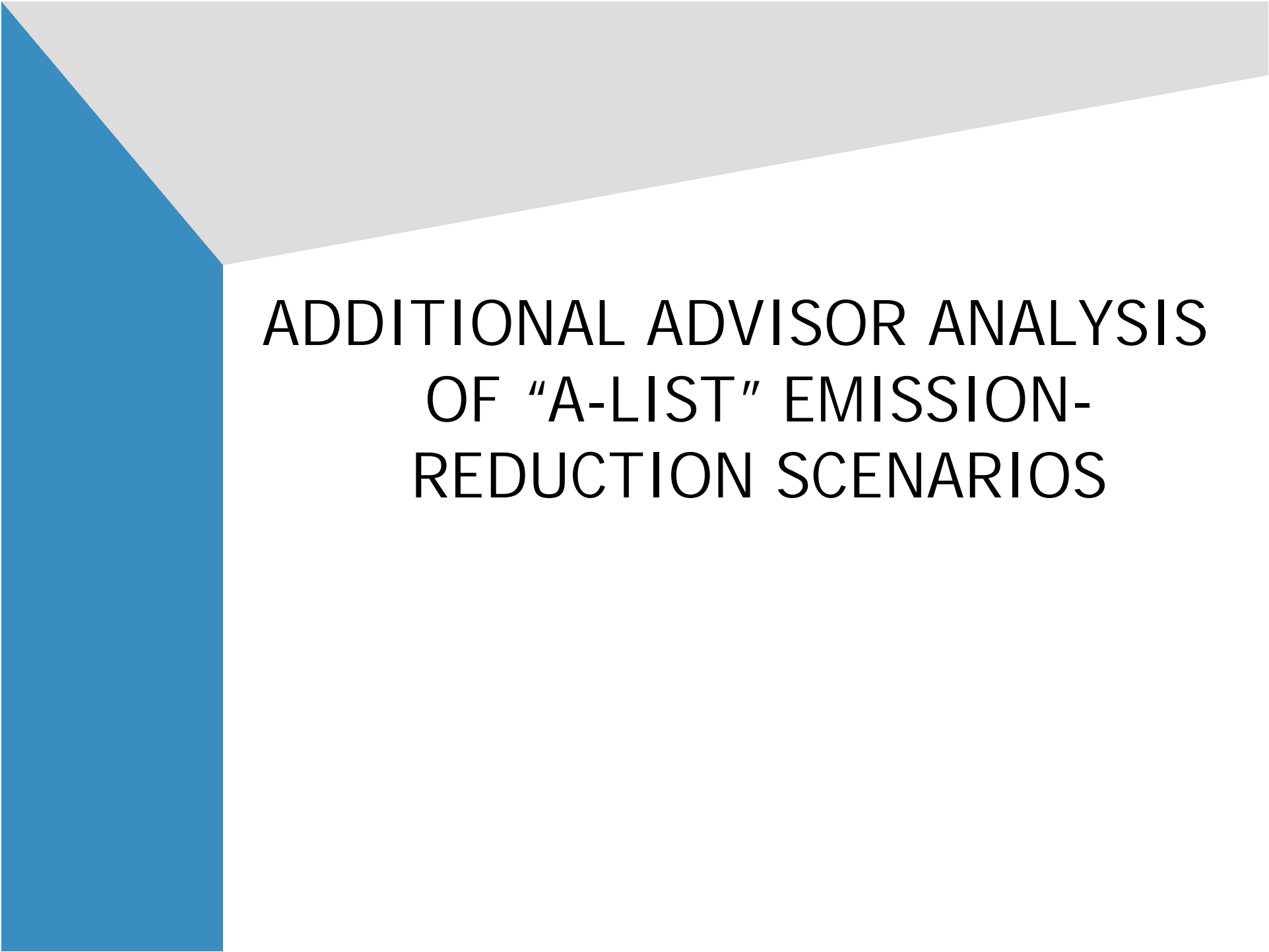


COMPARISON OF SIMULATED 8-HR OZONE EXCEEDANCE EXPOSURE



COMPARISON OF SIMULATED 8-HR OZONE EXCEEDANCE EXPOSURE





ADDITIONAL ADVISOR ANALYSIS OF “A-LIST” EMISSION- REDUCTION SCENARIOS

SUMMARY OF RESULTS FOR ATMOS "A-LIST"

- Contribution to max 8-hour ozone from non-ATMOS states ranges from 4 to 18 ppb for the areas of interest and is greatest for Chattanooga (followed by Tupelo then Little Rock)
- For all areas, NO_x reductions are more effective than VOC reductions in reducing 8-hour ozone
- VOC reductions always provide some additional benefit

SUMMARY OF RESULTS FOR ATMOS "A-LIST"

- For all areas, low-level NO_x reductions are more effective in reducing 8-hour ozone than elevated NO_x reductions (on a percentage basis) – “how much more” varies by area
- Considering only Grid 3 portions of TN, AR, and MS, local emission reductions account for most of the ozone reductions in the areas of interest

ATMOS EAC MODELING ANALYSIS: NEAR-TERM SCHEDULE

- Develop 2007 inventory by 10 March
- Run 2007 simulation by 14 March
- Provide ADVISOR file by 19 March